Fastener Tightening Specifications

Application	Specification	
	Metric	English
A/C		
Compressor Bolt - Front	22 N·m	17 lb ft
Compressor Bolt - Rear	22 N·m	17 lb ft
Compressor Bracket Bolt - Front	58 N·m	43 lb ft
Compressor Hose Assembly Bolt	9 N·m	80 lb in
Alternator		
Nut	58 N·m	43 lb ft
Bracket Bolt - Side-M10	58 N·m	43 lb ft
Bracket Bolt - Front-M10	58 N·m	43 lb ft
Bracket Bolt - Side-M8	22 N·m	16 lb ft
Cable Nut	13 N·m	115 lb in
Camshaft Position Actuator		
Camshaft Bolt	58 N·m	43 lb ft
Oil Control Valve Bolt	10 N·m	89 lb in
Camshaft Cap Bolt	10 N·m	89 lb in
Camshaft Cover Bolt	10 N·m	89 lb in
Camshaft Intermediate Drive Sprocket Bolt - Idler Sprocket	58 N·m	43 lb ft
Camshaft Position Sensor Bolt	10 N·m	89 lb in
Catalytic Converter		
Exhaust Manifold Nut	50 N·m	37 lb ft
Close Out Cover Bolt	10 N·m	89 lb in
Connecting Rod Bolt		
First Pass	30 N·m	22 lb ft
Second Pass - Counter Clockwise	Back Off to Zero	
Third Pass	25 N·m	18 lb ft
Final Pass	110 Degrees	
Coolant Outlet Bolt	10 N·m	89 lb in
Crankshaft Balancer Bolt		
First Pass	100 N·m	74 lb ft
Final Pass	150 Degrees	
Crankshaft Main Bearing Bolt		
Inner		
First Pass	20 N·m	15 lb ft
Final Pass	80 degrees	
Outer		

© 2010 General Motors Corporation. All rights reserved.

- First Pass	15 N·m	10 lb ft
- Final Pass	110 Degrees	
Side		
- First Pass	30 N·m	22 lb ft
- Final Pass	60 Degrees	
Crankshaft Position Sensor Bolt	10 N·m	89 lb in
Crankshaft Rear Oil Seal Housing Bolt	10 N·m	89 lb in
Cylinder Head Bolt - M8		
- First Pass	15 N·m	10 lb ft
- Final Pass	60 Degrees	
Cylinder Head Bolt - M11		
- First Pass	45 N·m	33 lb ft
- Second Pass	Counter Clockwise 120 degrees	
- Third Pass	30 N·m	22 lb ft
- Final Pass	150 degrees	
Cylinder Head Core Hole Plug	45 N·m	33 lb ft
Drive Belt		
- Idler Pulley Bolt	58 N·m	43 lb ft
- Tensioner Bolt	22 N·m	16 lb ft
ECM		
- Bolt	10 N·m	89 lb in
- Bracket Bolt - Front	23 N·m	17 lb ft
- Bracket Bolt - Side	10 N·m	89 lb in
- Grounding Bolt	4.5 N·m	40 lb in
ECT Sensor	25 N·m	16 lb ft
Pressure Plate to Flywheel Retaining Bolts		
First Pass	15 N·m	11 lb ft
Second Pass	30 N·m	22 lb ft
Third Pass	90° Degrees	
Engine Front Cover Bolt		
- First Pass	20 N·m	15 lb ft
- Final Pass	60 Degrees	
Engine Cover Bracket Bolt	35 N·m	26 lb ft
Engine Mount		
- Bracket Bolt to Engine Block - M8	38 N·m	28 lb ft
- Bracket Bolt to Engine Block - M10	50 N·m	37 lb ft
- Nut to Engine Mount Bracket	80 N·m	59 lb ft
- Nut to Frame	80 N·m	59 lb ft
Evaporative Emission (EVAP) Purge Valve Bolt	10 N·m	89 lb in
Engine Wiring Harness Bracket		

ı Bolt - Cylinder Head Rear	40 N·m	30 lb ft
ı Bolt - ECM Bracket Side	23 N·m	17 lb ft
ı Bolt - ECM Bracket Top	10 N·m	89 lb in
ı Bolt - Oil Filter Adapter- M8	24 N·m	18 lb ft
ı Bolt - Oil Filter Adapter- M10	58 N·m	43 lb ft
ı Bolt - Oil Pan- M6	10 N·m	89 lb in
ı Bolt - Oil Pan- M8	22 N·m	16 lb ft
ı Bolt - Near Crankshaft Position Sensor	10 N·m	89 lb in
ı Bolt - Right Side Block Front	23 N·m	17 lb ft
ı Bolt - Right Side Head Front	10 N·m	89 lb in
Engine Wiring Harness Ground		
ı Bolt - ECM Bracket Top	10 N·m	89 lb in
ı Bolt - Left Cylinder Head Side	10 N·m	89 lb in
ı Bolt - Right Cylinder Head Rear	10 N·m	89 lb in
Exhaust Manifold		
ı Bolt	20 N·m	15 lb ft
ı Heat Shield Bolt	10 N·m	89 lb in
Fuel Rail Bolt	10 N·m	89 lb in
Ground Cable Bolt	50 N·m	37 lb ft
Heater Inlet/Outlet Pipe Assembly Bolt	10 N·m	89 lb in
Ignition Coil Bolt	10 N·m	89 lb in
Intake Manifold		
ı Brace Bolt - Engine Front Cover M12	65 N·m	48 lb ft
ı Brace Bolt/Ball Stud - Intake Manifold M6	10 N·m	89 lb in
ı Engine Cover Ball Stud	9 N·m	80 lb in
ı Tuning Valve Bolt	10 N·m	89 lb in
ı Upper-to-Cylinder Head Bolt - Long	23 N·m	17 lb ft
ı Upper-to-Cylinder Head Bolt - Short	23 N·m	17 lb ft
ı Upper-to-Lower Intake Manifold Bolt	23 N·m	17 lb ft
Knock Sensor Bolt	23 N·m	17 lb ft
Oil Drain Plug	25 N·m	18 lb ft
Oil Filter Cap	25 N·m	18 lb ft
Oil Filter Adapter		
ı Oil Filter Adapter to Cylinder Head Retaining Bolt - M10	65 N·m	48 lb ft
ı Oil Filter Adapter to Cylinder Block Retaining Bolts - M8	23 N·m	17 lb ft
Oil Gallery Plug	31 N·m	23 lb ft
Oil Level Indicator Tube Bracket to Cylinder Head Retaining Bolt	10 N·m	89 lb in
Oil Level Sensor Bolt	10 N·m	89 lb in
Oil Pan		
ı Bolt - Block M8	23 N·m	17 lb ft

ı Bolt - Crankshaft Rear Oil Seal Housing M6	10 N·m	89 lb in
ı oil pan baffle to oil pan retaining bolts	10 N·m	89 lb in
ı oil pan scraper to oil pan retaining bolts	10 N·m	89 lb in
Oil Pressure Sender	20 N·m	15 lb ft
Oil Pump		
ı Bolt	25 N·m	18 lb ft
ı Cover Bolt	13 N·m	115 lb in
Oxygen Sensor		
ı Pump Converter Pipe	40 N·m	30 lb ft
PCV Tube Bracket Bolt	10 N·m	89 lb in
Piston Oil Cooling Nozzle Bolt	10 N·m	89 lb in
Power Steering Pump		
ı Bracket to Engine Bolt	58 N·m	43 lb ft
ı Pump to Bracket Bolt	22 N·m	16 lb ft
ı Reservoir to Front Cover Bolt	9 N·m	80 lb in
Primary Camshaft Drive Chain		
ı Left Guide Bolt - Oil Pump	13 N·m	115 lb in
ı Tensioner Bolt	23 N·m	17 lb ft
ı Upper Guide Bolt	23 N·m	17 lb ft
Radiator Outlet Pipe		
ı Bolt - Alternator Bracket	23 N·m	17 lb ft
ı Bolt - Right Cylinder Head Rear	50 N·m	37 lb ft
ı Bolt - Thermostat Housing	10 N·m	89 lb in
Secondary Camshaft Drive Chain		
ı Guide Bolt	23 N·m	17 lb ft
ı Shoe Bolt	23 N·m	17 lb ft
ı Tensioner Bolt	23 N·m	17 lb ft
Spark Plug	18 N·m	13 lb ft
Starter Motor		
ı Bolt	50 N·m	37 lb ft
ı Cable Nut	13 N·m	115 lb in
Suction Tube Bolt	10 N·m	89 lb in
Suction Screen Bolt	10 N·m	89 lb in
Thermostat Housing Bolt	10 N·m	89 lb in
Throttle Body Bolt	10 N·m	89 lb in
Torque Converter Bolt	60 N·m	44 lb ft
Transmission		
ı Mount Bolt to Transmission - RPO M82	60 N·m	45 lb ft
ı Range Selector Lever Nut	9.5 N·m	84 lb in
ı To Engine Bolt	50 N·m	37 lb ft

Water Pump		
Bolt	10 N·m	89 lb in
Pulley Bolt	10 N·m	89 lb in

Engine Mechanical Specifications

LY7

Application	Specification	
	Metric	English
General		
Engine Type	V-6	
Displacement	3564 cu cm	218 cu in
RPO	LY7	
Engine Performance	195 kW 340 N·m	261 hp 250 lb ft
Bore	94 mm	3.700 in
Stroke	85.6 mm	3.370 in
Compression Ratio	10.2:1	
Cranking RPM - at 40° C (104°F)	80 RPM	
Idle Speed RPM	700 A/C Off - 700 A/C On	
Firing Order	1-2-3-4-5-6	
Spark Plug Gap	1.1 mm / 1.2 mm	0.0433 in / 0.0472 in
Block		
Crankshaft Main Bearing Bore Diameter	72.867-72.881 mm	2.8688-2.8693 in
Cylinder Bore Diameter	94 mm	3.7008 in
Cylinder Bore Out-of-Round - Production Max.	0.013 mm	0.0005 in
Camshaft		
Camshaft Bearing Inside Diameter - Front Number 1	35.000-35.020 mm	1.3779-1.3787 in
Camshaft Bearing Inside Diameter - Middle and Rear Number 2-4	27.000-27.020 mm	1.0630-1.0638 in
Camshaft End Play	0.045-0.215 mm	0.0018-0.0085 in
Camshaft Journal Diameter - Front, 1	34.936-34.960 mm	1.3754-1.3764 in
Camshaft Journal Diameter - Middle and Rear, 2-4	26.936-26.960 mm	1.0605-1.0614 in
Camshaft Journal Out-of-Round	0.006 mm	0.0002 in
Camshaft Journal to Bore Clearance	0.040-0.084 mm	0.0016-0.0033 in
Camshaft Lobe Duration - Exhaust @ 0.150 mm (0.0059 in) Lift	238 degrees	
Camshaft Lobe Duration - Intake @ 0.150 mm (0.0059 in) Lift	226 degrees	
Camshaft Lobe Lift - Exhaust	42.456-42.756 mm	1.6715-1.6833 in

© 2010 General Motors Corporation. All rights reserved.

Camshaft Lobe Lift - Intake	42.385-42.685 mm	1.6687-1.6805 in
Camshaft Lobe Overlap @ 0.150 mm (0.0059 in) Lift	0 degrees	
Camshaft Runout - Front and Rear, 1 and 4	0.025 mm	0.0010 in
Camshaft Runout - Middle 2 and 3	0.050 mm	0.0020 in
Camshaft Timing @ 0.15 mm (0.0059 in) Lift		
Valve Opens - Exhaust	229 degrees BTDC	
Valve Opens - Intake	14 degrees ATDC	
Centerline - Exhaust	111 degrees ATDC	
Centerline - Intake	132 degrees ATDC	
Valve Closes - Exhaust	9 degrees ATDC	
Valve Closes - Intake	252 degrees ATDC	
Valve Lift - Exhaust	10.95 mm	0.431 in
Valve Lift - Intake	10.95 mm	0.431 in
Camshaft Phasing		
Intake	0- -50° Crank (advance)	
Exhaust	0- +50° Crank (retard)	
Cooling System		
Thermostat Start Opening Temperature	82°C +/- 2°C	179.6°F +/- 3.6° F
Thermostat Full Open Temperature	95°C	203°F
Connecting Rod		
Connecting Rod Bearing Clearance	0.010-0.070 mm	0.0004-0.0028 in
Connecting Rod Bore Diameter - Bearing End	59.620-59.636 mm	2.3472-2.3479 in
Connecting Rod Bore Diameter - Pin End	24.007-24.021 mm	0.9452-0.9457 in
Connecting Rod Length - Center to Center	150.4 mm	5.921 in
Connecting Rod Side Clearance	0.095-0.355 mm	0.0037-0.0140 in
Connecting Rod Width - Bearing End		
Production	21.775 mm	0.8573 in
Service	21.770-21.780 mm	0.8571-0.8575 in
Connecting Rod Width - Pin End		
Production	26.000 mm	1.0236 in
Service	25.950-26.050 mm	1.0217-1.0256 in
Crankshaft		
Connecting Rod Journal Diameter	55.992-56.008 mm	2.2044-2.2050 in
Connecting Rod Journal Out-of-Round	0.005 mm	0.0002 in
Connecting Rod Journal Taper	0.005 mm	0.0002 in

Connecting Rod Journal Width		
Production	22.000 mm	0.8661 in
Service	21.920-22.080 mm	0.8630-0.8693 in
Crankshaft End Play	0.100-0.330 mm	0.0039-0.0130 in
Crankshaft Main Bearing Clearance	0.010-0.060 mm	0.0004-0.0024 in
Crankshaft Main Journal Diameter	67.992-68.008 mm	2.676-2.677 in
Crankshaft Main Journal Out-of-Round	0.005 mm	0.0002 in
Crankshaft Main Journal Taper	0.005 mm	0.0002 in
Crankshaft Main Journal Thrust Wall		
Runout	0.000-0.040 mm	0.0000-0.0016 in
Square	0.000-0.010 mm	0.0000-0.0004 in
Crankshaft Main Journal Width, #1, 2, 4		
Production	24.000 mm	0.9449 in
Service	23.900-24.100 mm	0.9409-0.9488 in
Crankshaft Main Journal Width, #3		
Production	24.400 mm	0.9606 in
Service	24.360-24.440 mm	0.9591-0.9622 in
Crankshaft Pilot Bearing Bore Diameter	20.965-20.995 mm	0.8254-0.8266 in
Crankshaft Rear Flange Runout	0.025 mm	0.0010 in
Crankshaft Reluctor Ring Runout - Maximum	0.5 mm	0.0020 in
Crankshaft Runout	0.030 mm	0.0012 in
Crankshaft Thrust Bearing Clearance	0.076-0.305 mm	0.0030-0.0120 in
Crankshaft Thrust Surface - Height Diameter	95.000 mm	3.7401 in
Crankshaft Thrust Surface Runout	0.040 mm	0.0016 in
Cylinder Head		
Combustion Chamber Volume	54.5 cc	3.325 cu in
Valve Guide Bore - Exhaust	6.005-6.025 mm	0.2362-0.2370 in
Valve Guide Bore - Intake	6.005-6.025 mm	0.2362-0.2370 in
Valve Guide Installed Height	14.050-14.550 mm	0.5531-0.5728 in
Valve Lifter Bore Diameter	12.008-12.030 mm	0.4728-0.4736 in
Lubrication System		
Oil Capacity - Wet Fill With Oil Filter Change	6.7 Liters	7.1 Quarts
Oil Pressure - Minimum @ Idle	74 kPa	10 psi
Oil Pressure - Minimum @ 2,000 RPM	377 kPa	54 psi
Piston Cooling Jet Valve Opening Pressure	1.8-2.2 bar	26-32 psi

Oil Pump		
Gear Diameter - Outer	87.095-87.175 mm	3.4289-3.4321 in
Gear Pocket - Depth	15.565-15.600 mm	0.6128-0.6142 in
Gear Pocket - Diameter	87.275-87.325 mm	3.4360-3.4380 in
Gear Thickness - Drive/Driven	15.511-15.536 mm	0.6107-0.6117 in
Gear-to-Cover Clearance - Drive/Driven	0.030-0.085 mm	0.0012-0.0033 in
Gear-to-Housing Clearance - Drive/Driven	0.100-0.230 mm	0.0039-0.0091 in
Inner Gear Tip Clearance	0.075-0.180 mm	0.0030-0.0071 in
Crankshaft Clearance to Housing	0.040-0.130 mm	0.0016-0.0051 in
Inner Gerotor Hub Diameter	53.310-53.335 mm	2.0988-2.0998 in
Housing Hub Diameter	53.380-53.420 mm	2.1016-2.1031 in
Inner Gerotor Hub Clearance to Housing	0.045-0.110 mm	0.0018-0.0043 in
Piston Ring End Gap		
First Compression Ring	0.150-0.300 mm	0.0059-0.0118 in
Second Compression Ring	0.280-0.480 mm	0.0110-0.0189 in
Oil Control Ring	0.150-0.600 mm	0.0059-0.0236 in
Piston Ring to Groove Clearance		
First Compression Ring	0.030-0.065 mm	0.0012-0.0026 in
Second Compression Ring	0.015-0.060 mm	0.0006-0.0024 in
Oil Control Ring	0.030-0.170 mm	0.0012-0.0669 in
Piston Ring Thickness		
First Compression Ring	1.175-1.190 mm	0.0463-0.0469 in
Second Compression Ring	1.470-1.495 mm	0.0579-0.0589 in
Oil Control Ring	2.360-2.480 mm	0.0929-0.0976 in
Pistons and Pins		
Piston Diameter	93.956-93.974 mm	3.5022-3.5029 in
Piston Pin Bore Diameter	24.005-24.009 mm	0.9452-0.9454 in
Piston Ring Groove Width - First Compression Ring	1.220-1.240 mm	0.0480-0.0488 in
Piston Ring Groove Width - Second Compression Ring	1.510-1.530 mm	0.0595-0.0602 in
Piston Ring Groove Width - Oil Control Ring	2.510-2.530 mm	0.0988-0.0996 in
Piston to Bore Clearance	0.026-0.052 mm	0.0008-0.0013 in
Pin		
Piston Pin Clearance to Connecting Rod Bore	0.007-0.024 mm	0.0003-0.0010 in

Piston Pin Clearance to Piston Pin Bore	0.004-0.015 mm	0.0003-0.0006 in
Piston Pin Diameter	23.997-24.000 mm	0.9448-0.9449 in
Piston Pin Length	60.6004-61.100 mm	2.5685-2.5882 in
Valve System		
Valve Face Angle	44.25 degrees	
Valve Face Runout	0.038 mm	0.0015 in
Valve Face Width - Exhaust	2.750 mm	0.1083 in
Valve Face Width - Intake	2.180 mm	0.0858 in
Valve Head Diameter- Exhaust	30.470-30.730 mm	1.199-1.209 in
Valve Head Diameter- Inlet	36.830-37.090 mm	1.45-1.46 mm
Valve Installed Height	35.26-36.69 mm	1.3870-1.4445 in
Valve Length - Exhaust	97.11 mm	3.8232 in
Valve Length - Intake	101.23 mm	3.9854 in
Valve Seat Angle - Seating Surface	45 degrees	
Valve Seat Angle - Relief Surface	30 degrees	
Valve Seat Angle - Undercut Surface	60 degrees	
Valve Seat Runout - Maximum	0.080 mm	0.0031 in
Valve Seat Width - Exhaust Seating Surface	1.400-1.800 mm	0.0551-0.0709 in
Valve Seat Width - Intake Seating Surface	1.000-1.400 mm	0.0394-0.0551 in
Valve Stem Diameter - Exhaust	5.955-5.975 mm	0.2344-0.2352 in
Valve Stem Diameter - Intake	5.955-5.975 mm	0.2344-0.2352 in
Valve Stem-to-Guide Clearance - Exhaust	0.040-0.08 mm	0.0014-0.0030 in
Valve Stem-to-Guide Clearance - Intake	0.030-0.070 mm	0.0010-0.0026 in
Valve Lifter Diameter	11.986-12.000 mm	0.4720-0.4724 in
Valve Lifter-to-Bore Clearance	0.037-0.041 mm	0.0015-0.0016 in
Rocker Arms		
Valve Rocker Arm Ratio	1.68 to 1	
Valve Rocker Arm Roller Diameter	17.740-17.800 mm	0.6987-0.7008 in
Valve Springs		
Valve Spring Coil Thickness	3.250 x 3.900 mm	0.1280 x 0.1535 in
Valve Spring Diameter - Inside Top	12.200-12.700 mm	0.4760-0.4957 in
Valve Spring Diameter - Outside Top	18.00-18.450 mm	0.7087-0.7264 in
Valve Spring Diameter - Inside Bottom	17.950-20.500 mm	0.7067-0.8071 in

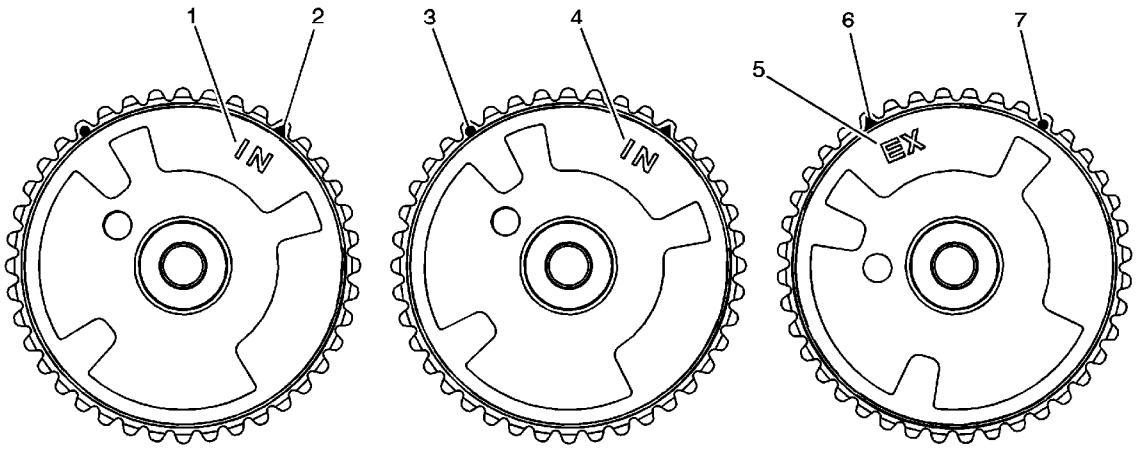
Valve Spring Diameter - Outside Bottom	26.000 mm	1.0236 in
Valve Spring Free Length	42.500-45.500 mm	1.6555-1.7657 in
Valve Spring Installed Height - Closed	35.000 mm	1.3779 in
Valve Spring Installed Height - Open	24.000 mm	0.9449 in
Valve Spring Load - Closed	247-273 N	56-61 lb
Valve Spring Load - Open	598-662 N	134-149 lb
Valve Spring Total Number of Coils	7.1	

Adhesives, Fluids, Lubricants, and Sealers

Application	Type of Material
Coolant and Oil Plug Threads	LOCTITE 242 ™ or equivalent
Oil Pan, Engine Front Cover, Crankshaft Rear Oil Seal Housing, Expansion Plugs	THREEBOND TB1207D™ or equivalent

© 2010 General Motors Corporation. All rights reserved.

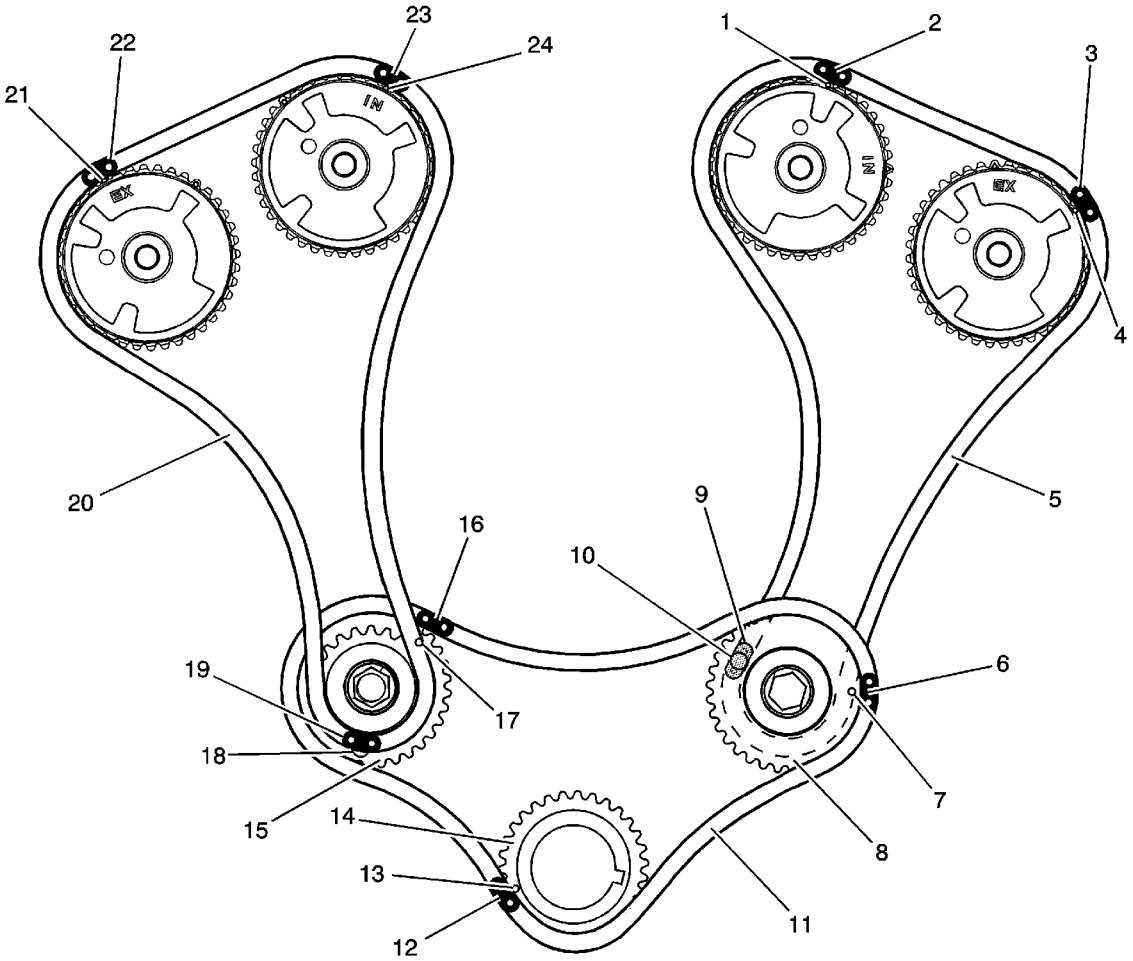
Camshaft Position Actuator Timing Marks



(1) Right Intake Camshaft Position Actuator Identifier
(2) Right Intake Camshaft Position Actuator Right Side Timing Mark - Triangle
(3) Left Intake Camshaft Position Actuator Left Side Timing Mark - Circle
(4) Left Intake Camshaft Position Actuator Identifier
(5) Exhaust Camshaft Position Actuator Identifier
(6) Exhaust Camshaft Position Actuator Right Side Timing Mark - Triangle
(7) Exhaust Camshaft Position Actuator Left Side Timing Mark - Circle

© 2010 General Motors Corporation. All rights reserved.

Stage Two

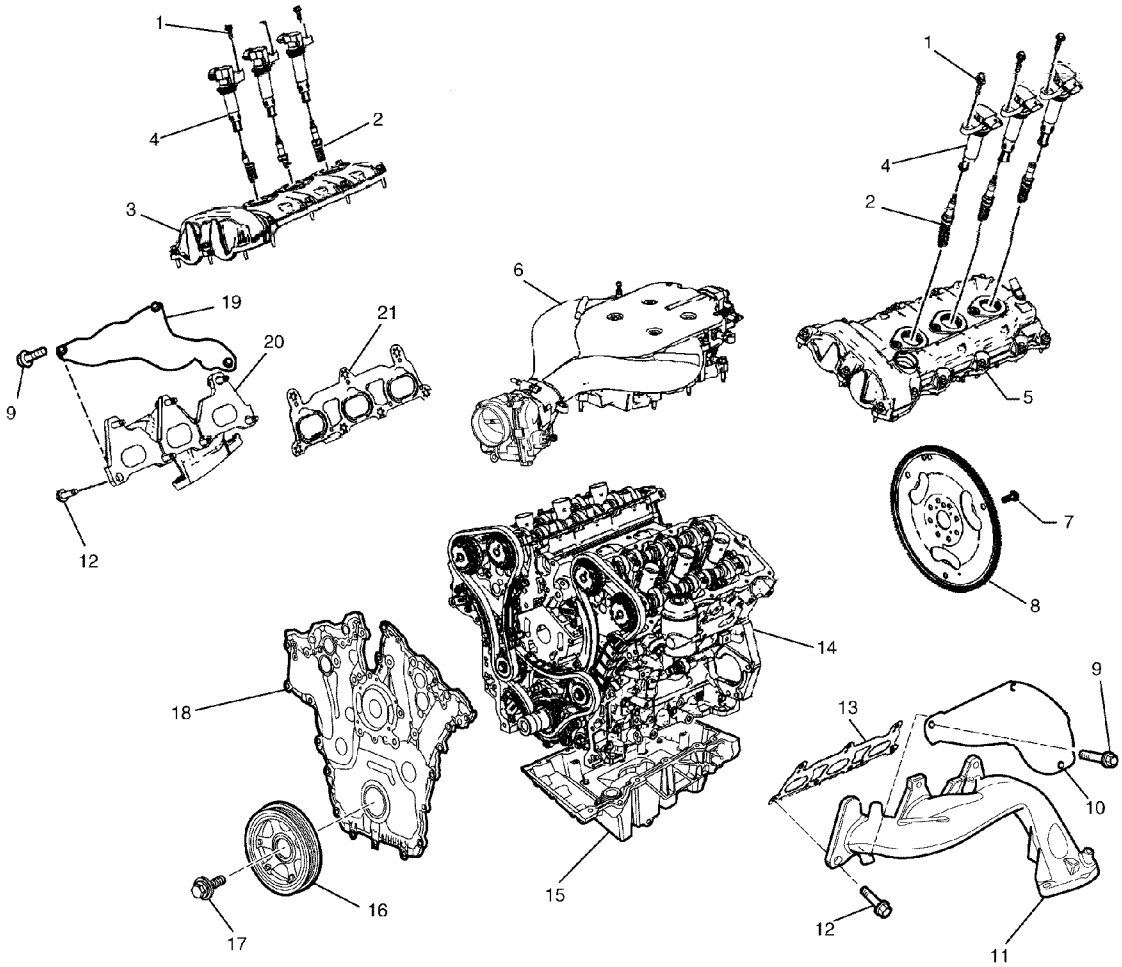


(1) Left Intake Camshaft Position (CMP) Actuator Timing Mark - Circle
(2) Left Intake Secondary Camshaft Timing Drive Chain Timing Link
(3) Left Exhaust Secondary Camshaft Timing Drive Chain Timing Link
(4) Left Exhaust Camshaft Position (CMP) Actuator Timing Mark - Circle
(5) Left Secondary Camshaft Timing Drive Chain
(6) Primary Camshaft Drive Chain Timing Link for the Left Primary Camshaft Intermediate Drive Chain Sprocket
(7) Left Primary Camshaft Intermediate Drive Chain Sprocket Timing Mark for the Primary Camshaft Drive Chain
(8) Left Primary Camshaft Intermediate Drive Chain Sprocket
Left Secondary Camshaft Timing Drive Chain Timing Link for the Left Primary Camshaft

© 2010 General Motors Corporation. All rights reserved.

(9) Intermediate Drive Chain Sprocket, behind hole in sprocket
(10) Left Primary Camshaft Intermediate Drive Chain Sprocket Timing Window
(11) Primary Camshaft Drive Chain
(12) Primary Camshaft Drive Chain Timing Link for the Crankshaft Sprocket
(13) Crankshaft Sprocket Timing Mark
(14) Crankshaft Sprocket
(15) Right Primary Camshaft Intermediate Drive Chain Sprocket
(16) Primary Camshaft Drive Chain Timing Link for the Right Primary Camshaft Intermediate Drive Chain Sprocket
(17) Right Primary Camshaft Intermediate Drive Chain Sprocket Timing Mark for the Primary Camshaft Drive Chain
(18) Right Primary Camshaft Intermediate Drive Chain Sprocket Timing Mark/Window for the Right Secondary Camshaft Timing Drive Chain
(19) Right Secondary Camshaft Timing Drive Chain Timing Link for the Right Primary Camshaft Intermediate Drive Chain Sprocket
(20) Right Secondary Camshaft Timing Drive Chain
(21) Right Exhaust Camshaft Position (CMP) Actuator Timing Mark - Triangle
(22) Right Exhaust Secondary Camshaft Timing Drive Chain Timing Link
(23) Right Intake Secondary Camshaft Timing Drive Chain Timing Link
(24) Right Intake Camshaft Position (CMP) Actuator Timing Mark - Triangle

Engine Covers and Component Assemblies (1 of 2)

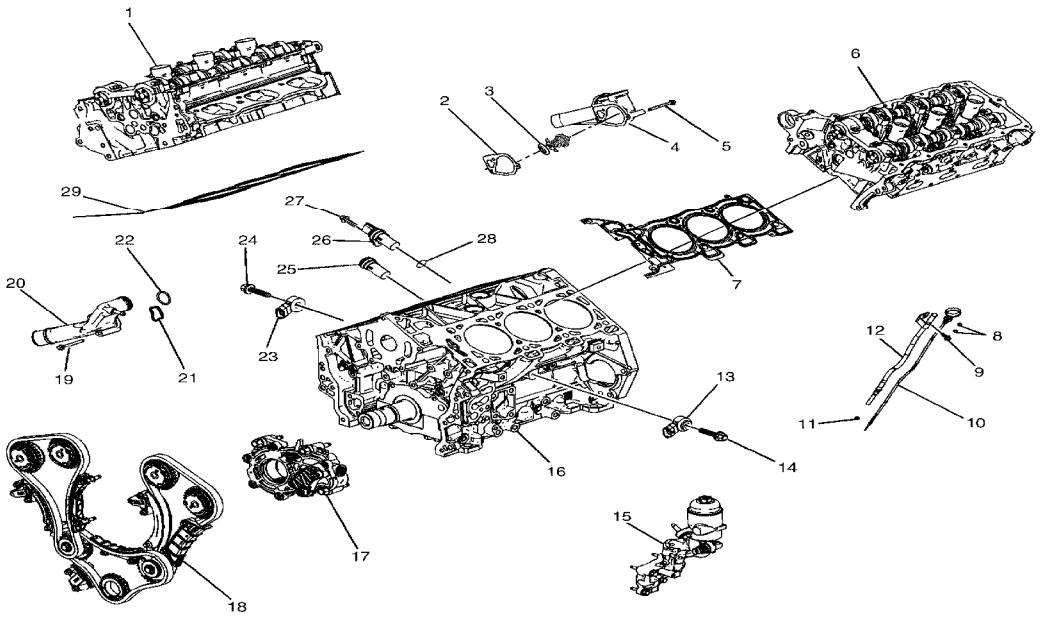


(1) Ignition Coil Assembly to Camshaft Cover Assembly Retaining Bolt
(2) Spark Plug
(3) Camshaft Cover Assembly - Right Side
(4) Ignition Coil Assembly
(5) Camshaft Cover Assembly - Left Side
(6) Intake Manifold Assembly
(7) Engine Flywheel to Crankshaft Retaining Bolt
(8) Engine Flywheel
(9) Exhaust Manifold Heat Shield to Exhaust Manifold Retaining Bolt
(10) Exhaust Manifold Heat Shield - Left Side
(11) Exhaust Manifold - Left Side

© 2010 General Motors Corporation. All rights reserved.

(12) Exhaust Manifold to Cylinder Head Retaining Bolt
(13) Exhaust Manifold Gasket - Left Side
(14) Engine Assembly
(15) Oil Pan Assembly
(16) Crankshaft Balancer
(17) Crankshaft Balancer to Crankshaft Retaining Bolt
(18) Engine Front Cover Assembly
(19) Exhaust Manifold Heat Shield - Right Side
(20) Exhaust Manifold - Right Side
(21) Exhaust Manifold Gasket - Right Side

Engine Covers and Component Assemblies (2 of 2)

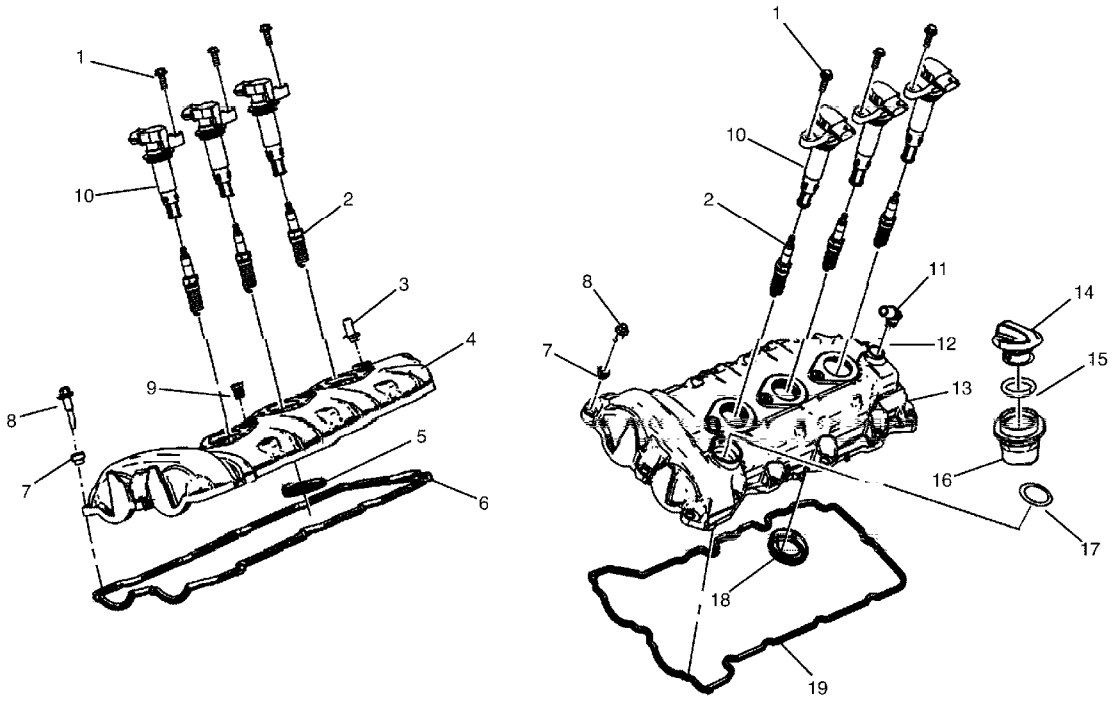


(1) Cylinder Head Assembly - Right Side
(2) Engine Cooling Thermostat Gasket
(3) Engine Cooling Thermostat
(4) Engine Cooling Thermostat Housing
(5) Engine Cooling Thermostat Housing Bolt
(6) Cylinder Head Assembly - Left Side
(7) Cylinder Head Gasket - Left Side
(8) Oil Level Indicator O-rings
(9) Oil Level Indicator Tube Bolt
(10) Oil Level Indicator
(11) Oil Level Indicator Tube O-ring
(12) Oil Level Indicator Tube
(13) Knock Sensor - Bank 1
(14) Knock Sensor to Cylinder Block Retaining Bolt - Bank 1
(15) Oil Filter Adapter Assembly
(16) Engine Short Block Assembly
(17) Oil Pump Assembly
(18) Timing Drive Assembly

© 2010 General Motors Corporation. All rights reserved.

(19) Water Outlet to Cylinder Block Retaining Bolt
(20) Water Outlet
(21) Water Outlet Seal
(22) Water Outlet O-ring
(23) Knock Sensor - Bank 2
(24) Knock Sensor to Cylinder Block Retaining Bolt - Bank 2
(25) Engine Coolant Heater
(26) Crankshaft Position Sensor
(27) Crankshaft Position Sensor to Cylinder Block Retaining Bolt
(28) Crankshaft Position Sensor O-ring
(29) Cylinder Head Gasket - Right Side

Camshaft Cover Assembly

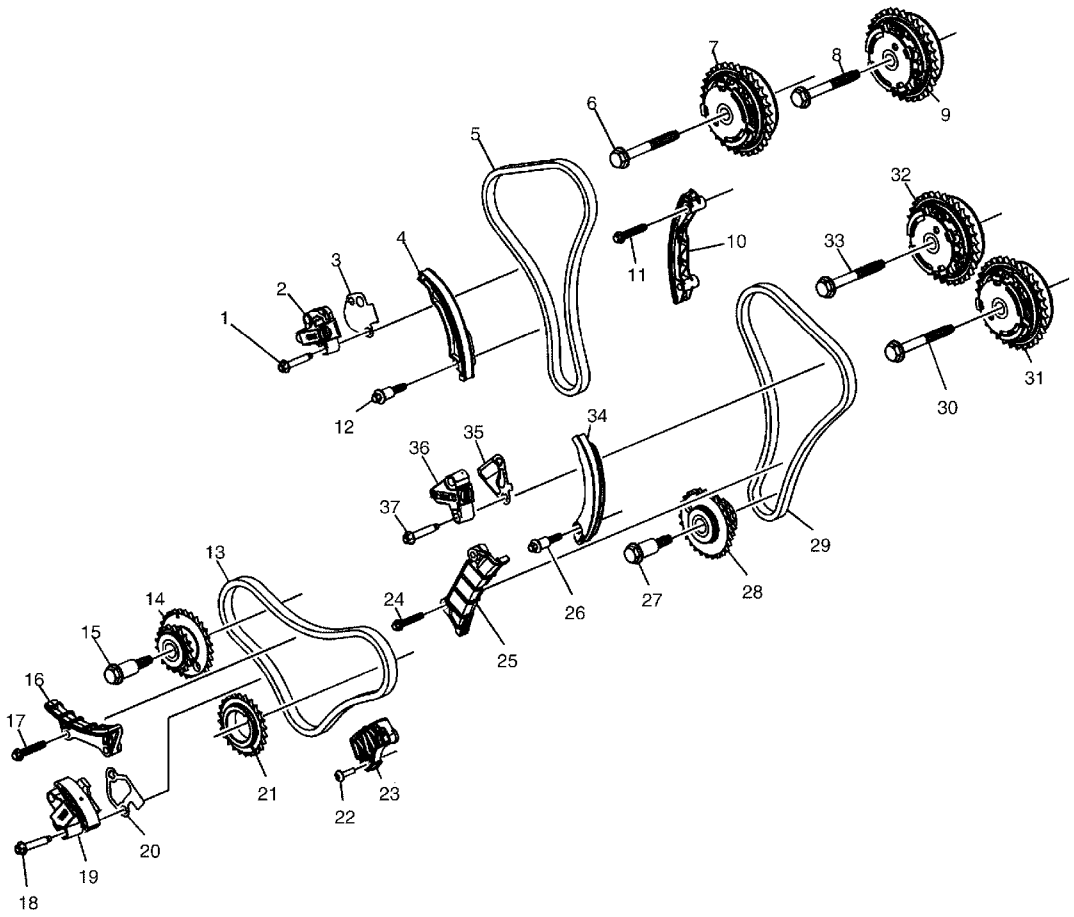


(1) Ignition Coil to Camshaft Cover Retaining Bolt
(2) Spark Plug
(3) Camshaft Cover PCV Fitting Orifice - Right Side
(4) Camshaft Cover - Right Side
(5) Camshaft Cover Spark Plug Port Seal - Right Side
(6) Camshaft Cover Gasket - Right Side
(7) Camshaft Cover Bolt Insulator
(8) Camshaft Cover Bolt
(9) Ignition Coil Bolt Thread Insert
(10) Ignition Coil

© 2010 General Motors Corporation. All rights reserved.

(11) Camshaft Cover PCV Fitting - Left Side
(12) Camshaft Cover PCV Fitting - Left Side
(13) Camshaft Cover - Left Side
(14) Oil Fill Cap
(15) Oil Fill O-Ring
(16) Oil Fill Tube
(17) Oil Fill O-Ring
(18) Camshaft Cover Spark Plug Port Seal - Left Side
(19) Camshaft Cover Gasket - Left Side

Camshaft Timing Components (LY7)

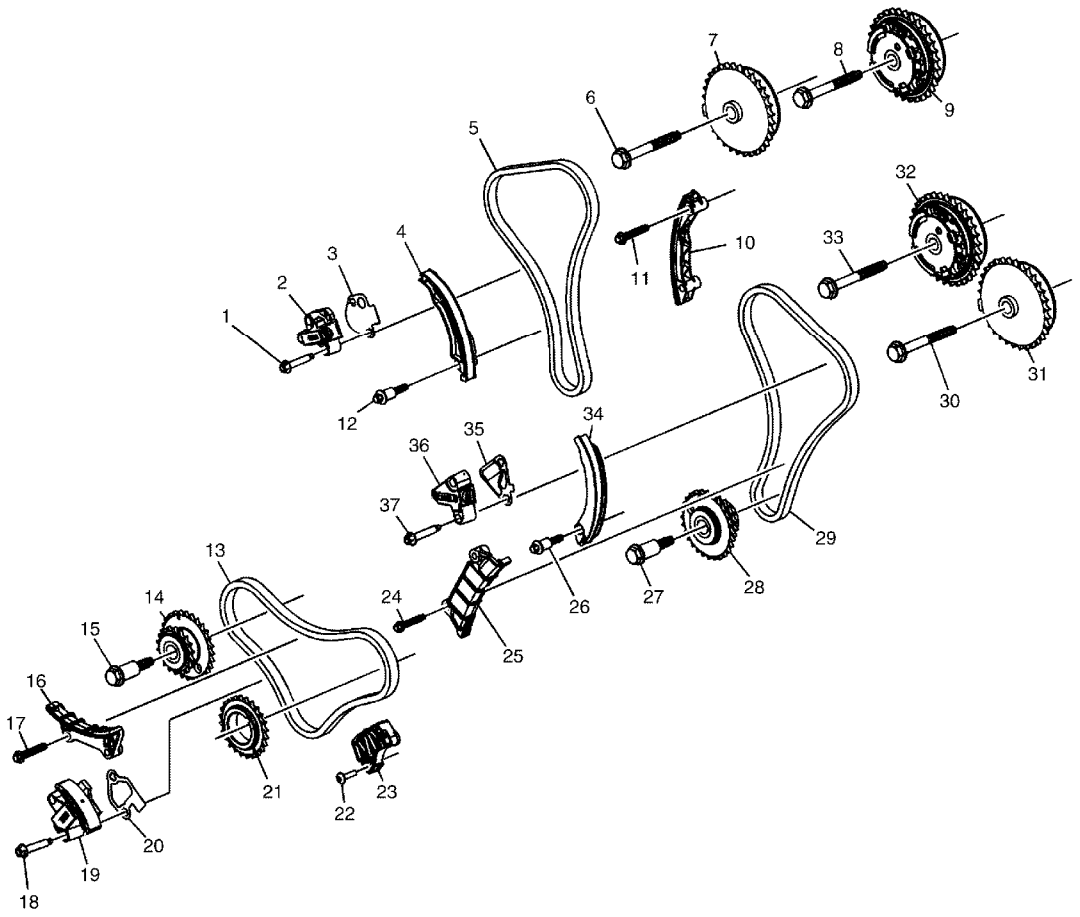


(1) Timing Chain Tensioner and Guide Bolt - Right Side
(2) Secondary Timing Chain Tensioner - Right Side
(3) Secondary Timing Chain Tensioner Gasket - Right Side
(4) Secondary Timing Chain Shoe - Right Side
(5) Secondary Timing Chain - Right Side
(6) Camshaft Position Actuator to Camshaft Retaining Bolt - Bank 2
(7) Exhaust Camshaft Position Actuator - Bank 2
(8) Camshaft Position Actuator to Camshaft Retaining Bolt - Bank 2
(9) Intake Camshaft Position Actuator - Bank 2
(10) Secondary Timing Chain Guide Bolt - Right Side
(11) Secondary Timing Chain Guide - Right Side

© 2010 General Motors Corporation. All rights reserved.

(12) Secondary Timing Chain Shoe Bolt - Right Side
(13) Primary Timing Chain
(14) Camshaft Intermediate Drive Chain Idler Sprocket
(15) Camshaft Intermediate Drive Chain Idler Sprocket Bolt
(16) Primary Timing Chain Upper Guide
(17) Primary Timing Chain Guide Bolt
(18) Primary Timing Chain Tensioner Bolt
(19) Primary Timing Chain Tensioner
(20) Primary Timing Chain Tensioner Gasket
(21) Crankshaft Sprocket
(22) Primary Timing Chain Lower Guide Bolt
(23) Primary Timing Chain Lower Guide
(24) Secondary Timing Chain Guide Bolt - Left Side
(25) Secondary Timing Chain Guide - Left Side
(26) Secondary Timing Chain Shoe Bolt - Left Side
(27) Camshaft Intermediate Drive Shaft Sprocket Bolt - Left Side
(28) Camshaft Intermediate Drive Shaft Sprocket - Left Side
(29) Secondary Timing Chain - Left Side
(30) Camshaft Position Actuator to Camshaft Retaining Bolt - Bank 1
(31) Exhaust Camshaft Position Actuator - Bank 1
(32) Intake Camshaft Position Actuator - Bank 1
(33) Camshaft Position Actuator to Camshaft Retaining Bolt - Bank 1
(34) Secondary Timing Chain Shoe - Left Side
(35) Secondary Timing Chain Tensioner Gasket - Left Side
(36) Secondary Timing Chain Tensioner - Left Side
(37) Timing Chain Tensioner Bolt - Left Side

Camshaft Timing Components (LE0 & LW2)

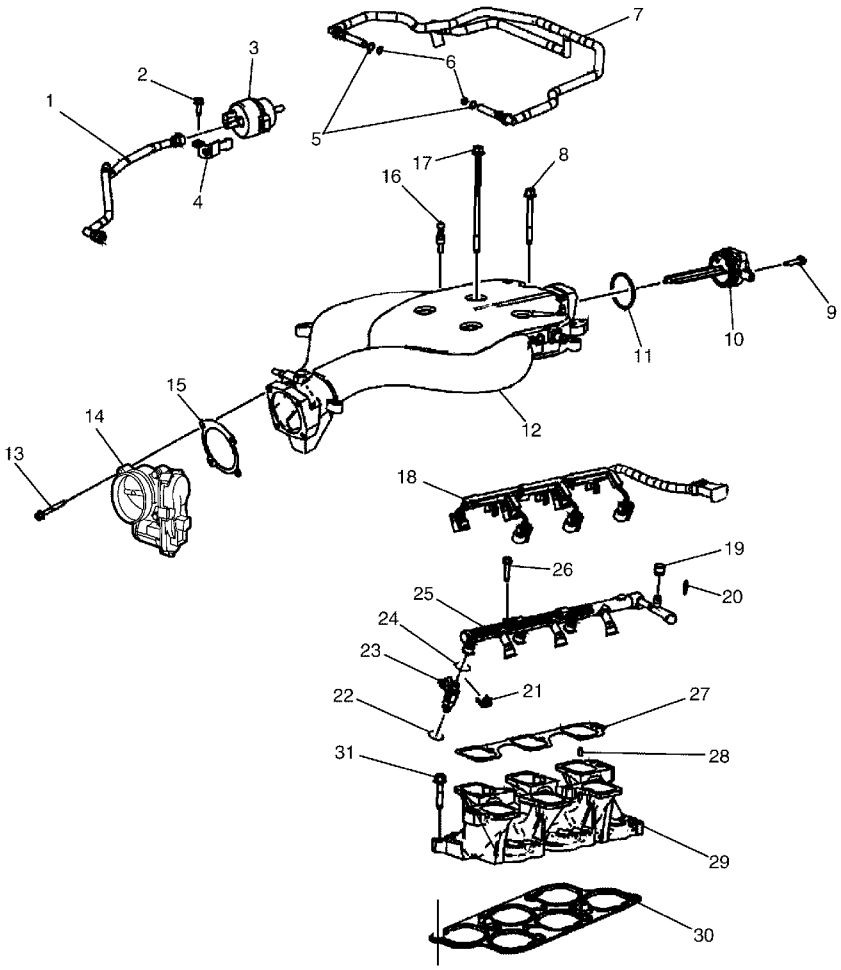


(1) Timing Chain Tensioner and Guide Bolt - Right Side
(2) Secondary Timing Chain Tensioner - Right Side
(3) Secondary Timing Chain Tensioner Gasket - Right Side
(4) Secondary Timing Chain Shoe - Right Side
(5) Secondary Timing Chain - Right Side
(6) Exhaust Camshaft Sprocket to Camshaft Retaining Bolt - Bank 2
(7) Exhaust Camshaft Sprocket - Bank 2
(8) Camshaft Position Actuator to Camshaft Retaining Bolt - Bank 2
(9) Intake Camshaft Position Actuator - Bank 2
(10) Secondary Timing Chain Guide Bolt - Right Side
(11) Secondary Timing Chain Guide - Right Side

© 2010 General Motors Corporation. All rights reserved.

(12) Secondary Timing Chain Shoe Bolt - Right Side
(13) Primary Timing Chain
(14) Camshaft Intermediate Drive Chain Idler Sprocket
(15) Camshaft Intermediate Drive Chain Idler Sprocket Bolt
(16) Primary Timing Chain Upper Guide
(17) Primary Timing Chain Guide Bolt
(18) Primary Timing Chain Tensioner Bolt
(19) Primary Timing Chain Tensioner
(20) Primary Timing Chain Tensioner Gasket
(21) Crankshaft Sprocket
(22) Primary Timing Chain Lower Guide Bolt
(23) Primary Timing Chain Lower Guide
(24) Secondary Timing Chain Guide Bolt - Left Side
(25) Secondary Timing Chain Guide - Left Side
(26) Secondary Timing Chain Shoe Bolt - Left Side
(27) Camshaft Intermediate Drive Shaft Sprocket Bolt - Left Side
(28) Camshaft Intermediate Drive Shaft Sprocket - Left Side
(29) Secondary Timing Chain - Left Side
(30) Exhaust Camshaft Sprocket to Camshaft Retaining Bolt - Bank 1
(31) Exhaust Camshaft Sprocket - Bank 1
(32) Intake Camshaft Position Actuator - Bank 1
(33) Camshaft Position Actuator to Camshaft Retaining Bolt - Bank 1
(34) Secondary Timing Chain Shoe - Left Side
(35) Secondary Timing Chain Tensioner Gasket - Left Side
(36) Secondary Timing Chain Tensioner - Left Side
(37) Timing Chain Tensioner Bolt - Left Side

Intake Manifold

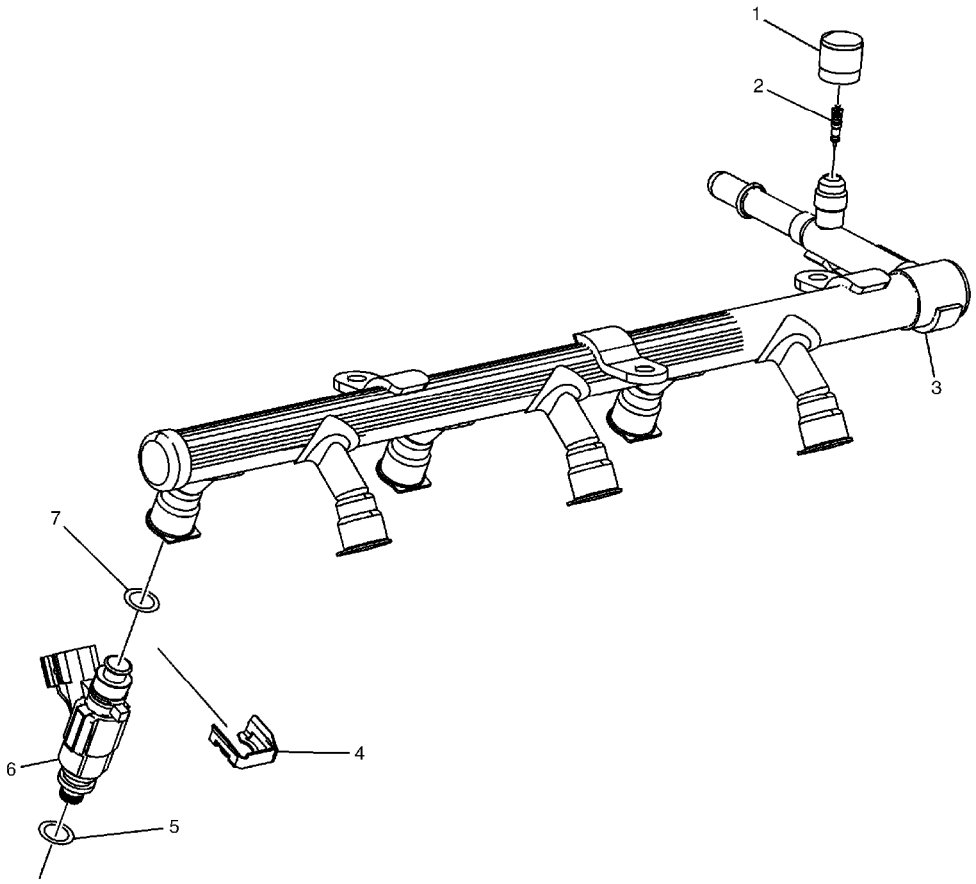


(1) Evaporative Emission (EVAP) Canister Purge Solenoid Valve Tube
(2) EVAP Canister Purge Solenoid Valve Bolt
(3) EVAP Canister Purge Solenoid Valve
(4) EVAP Canister Purge Solenoid Valve Bracket
(5) Positive Crankcase Ventilation (PCV) Hose O-Ring Outer/Larger
(6) PCV Hose O-Ring Inner/Smaller
(7) PCV Hose
(8) Upper Intake Manifold Bolt - Short
(9) Intake Manifold Runner Control Flap Retaining bolt
(10) Intake Manifold Runner Control Flap
(11) Intake Manifold Runner Control Flap O-Ring

© 2010 General Motors Corporation. All rights reserved.

(12) Upper Intake Manifold Assembly
(13) Throttle Body Retaining Bolt
(14) Throttle Body
(15) Throttle Body Gasket
(16) Engine Cover Ball Stud
(17) Upper Intake Manifold Bolt - Long
(18) Fuel Injector Wiring Harness
(19) Fuel Pressure Service Valve Cap
(20) Fuel Pressure Service Valve
(21) Fuel Injector Retaining Clip
(22) Fuel Injector Lower Seal
(23) Fuel Injector
(24) Fuel Injector Upper Seal
(25) Fuel Rail
(26) Fuel Rail Bolt
(27) Upper Intake Manifold Gasket
(28) Lower Intake Manifold to Upper Intake Manifold Guide Pin
(29) Lower Intake Manifold
(30) Lower Intake Manifold Gasket
(31) Lower Intake Manifold Retaining Bolt

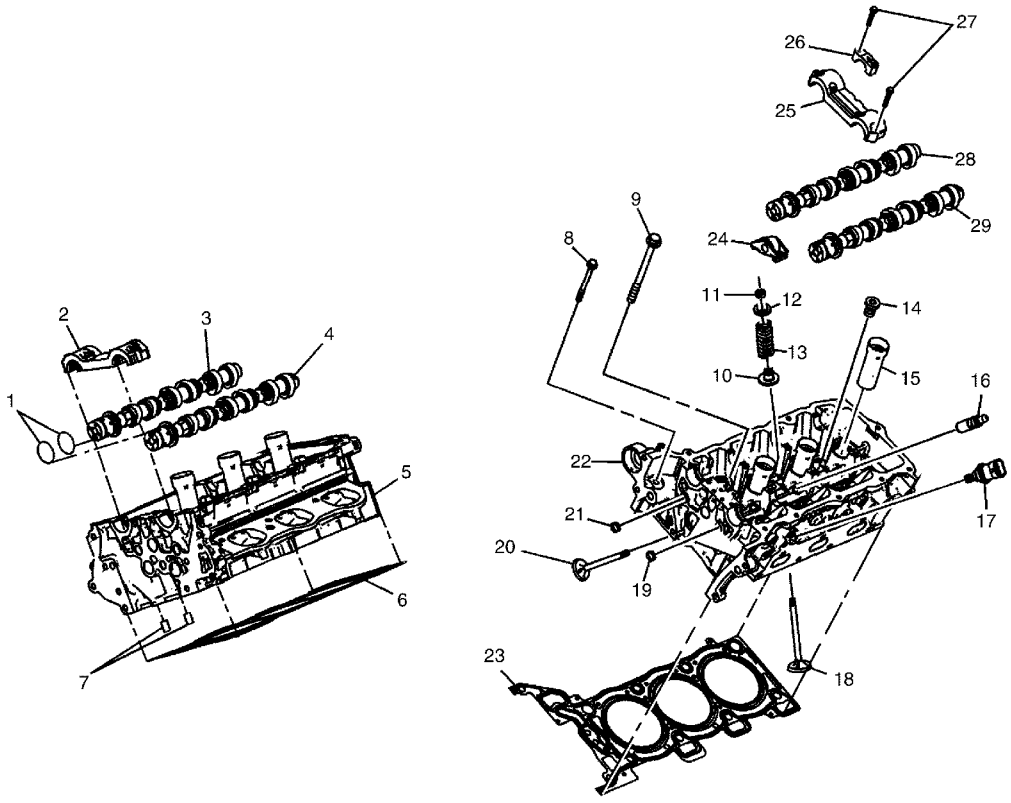
Fuel Rail



(1) Fuel Pressure Service Valve Cap
(2) Fuel Pressure Service Valve
(3) Fuel Rail
(4) Fuel Injector Retainer
(5) Fuel Injector Lower Seal
(6) Fuel Injector
(7) Fuel Injector Upper Seal

© 2010 General Motors Corporation. All rights reserved.

Cylinder Head Assemblies

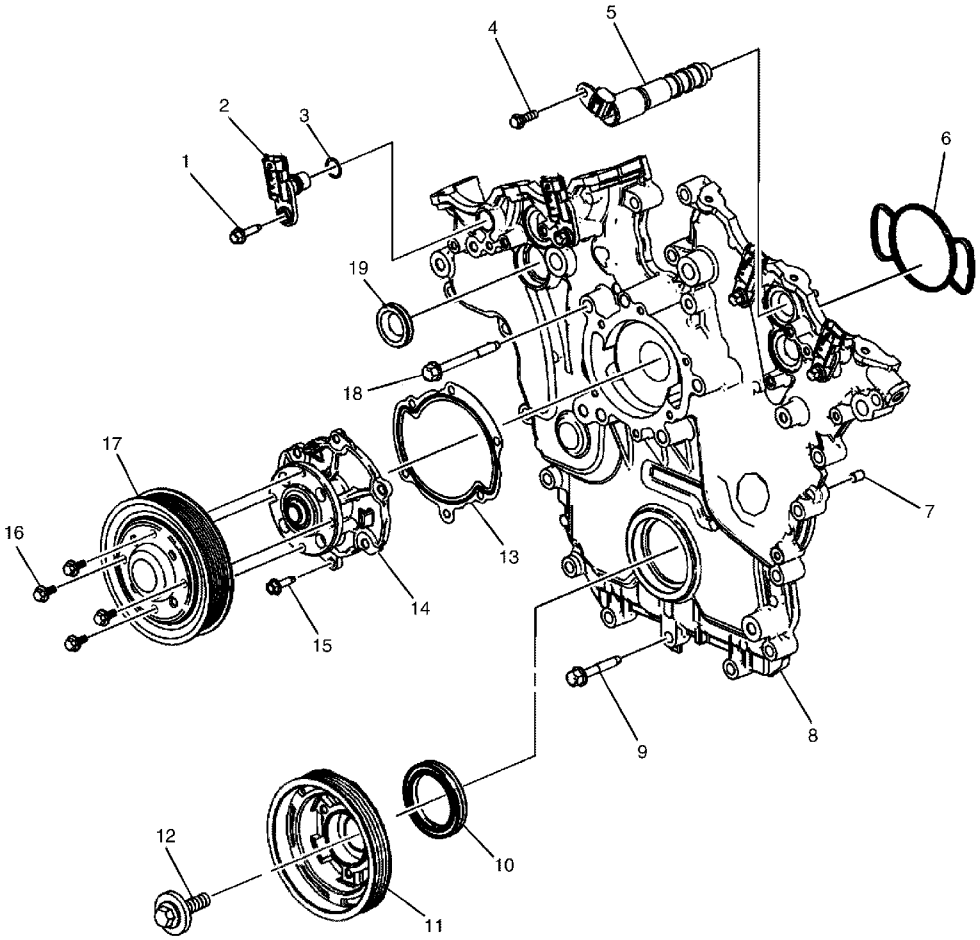


(1) Camshaft Oil Seal Ring
(2) Cylinder Head Camshaft Front Thrust Bearing Cap
(3) Exhaust Camshaft - Right Side
(4) Intake Camshaft - Right Side
(5) Cylinder Head - Right Side
(6) Cylinder Head Gasket - Right Side
(7) Cylinder Head Oil Gallery Check Valve
(8) Cylinder Head Front Bolt
(9) Cylinder Head Bolt
(10) Valve Stem Oil Seal

© 2010 General Motors Corporation. All rights reserved.

(11) Valve Collets
(12) Valve Spring Cap
(13) Valve Spring
(14) Cylinder Head Coolant Hole Threaded Plug
(15) Spark Plug Sleeve
(16) Hydraulic Valve Lash Adjuster Assembly
(17) Engine Coolant Temperature Sensor
(18) Exhaust Valve
(19) Cylinder Head Oil Gallery Expansion Plug - 14 mm
(20) Intake Valve
(21) Cylinder Head Oil Gallery Expansion Plug - 14 mm
(22) Cylinder Head - Left Side
(23) Cylinder Head Gasket - Left Side
(24) Valve Rocker Arm Assembly
(25) Cylinder Head Camshaft Front Thrust Bearing Cap
(26) Cylinder Head Camshaft Cap - Intermediate
(27) Cylinder Head Camshaft Cap Bolt
(28) Intake Camshaft - Left Side
(29) Exhaust Camshaft - Left Side

Engine Front Cover

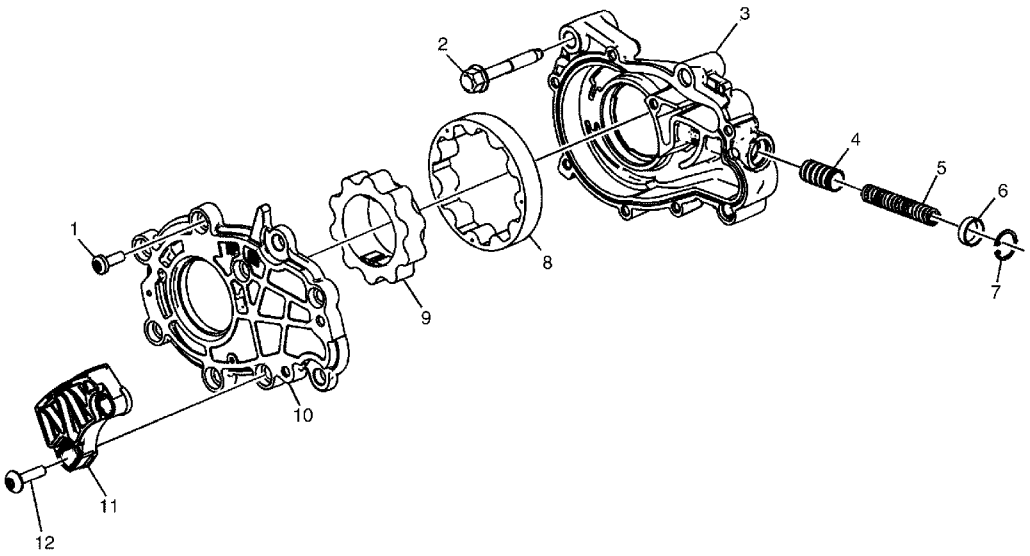


(1) Camshaft Position Sensor Bolt
(2) Camshaft Position Sensor
(3) Camshaft Position Sensor O-Ring
(4) Camshaft Position Actuator Solenoid Valve to Engine Front Cover Retaining Bolt
(5) Camshaft Position Actuator Solenoid Valve
(6) Engine Front Cover to Cylinder Block Seal
(7) Engine Front Cover Guide Pin
(8) Engine Front Cover
(9) Engine Front Cover Retaining Bolt
(10) Crankshaft Front Oil Seal
(11) Crankshaft Balancer

© 2010 General Motors Corporation. All rights reserved.

(12) Crankshaft Balancer Bolt
(13) Water Pump Gasket
(14) Water Pump Assembly
(15) Water Pump Bolt
(16) Water Pump Pulley Bolt
(17) Water Pump Pulley
(18) Engine Front Cover Retaining Bolt
(19) Camshaft Position Actuator Solenoid Valve Seal

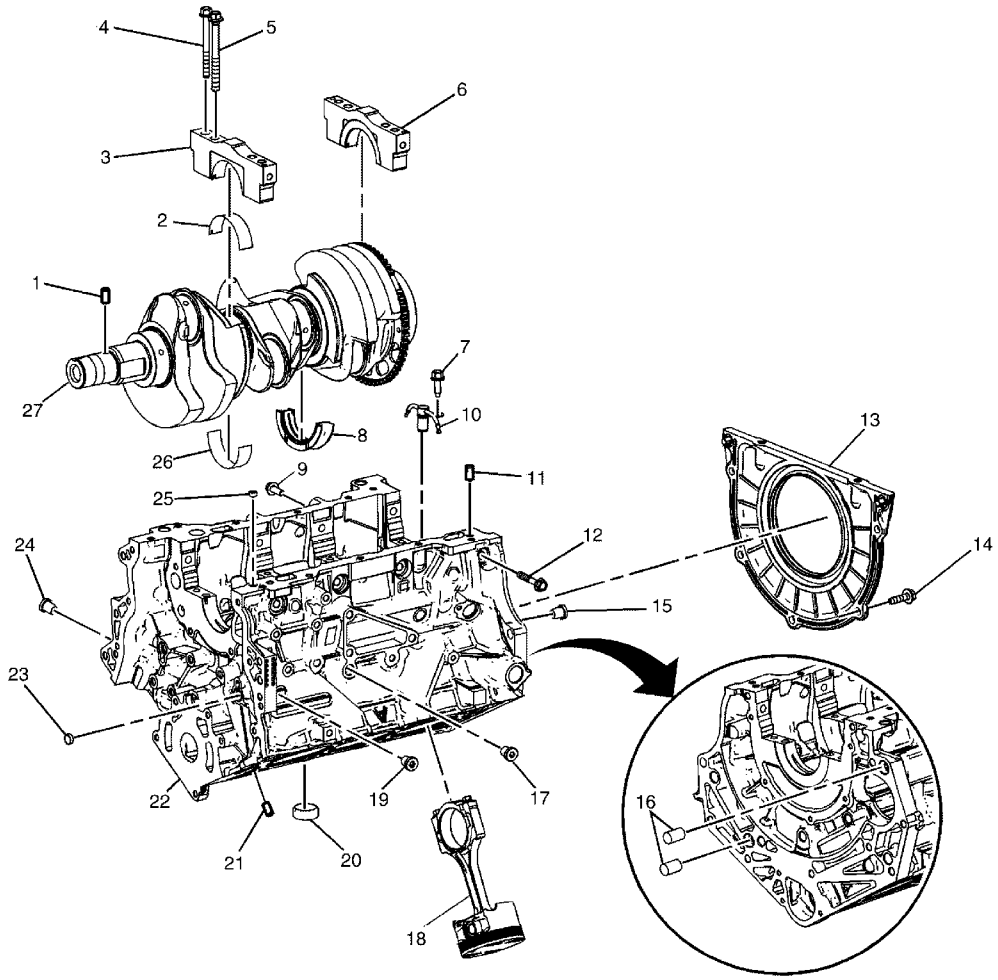
Oil Pump



(1) Oil Pump Cover Retaining Bolt
(2) Oil Pump Retaining Bolt
(3) Oil Pump Housing
(4) Oil Pressure Relief Valve
(5) Oil Pressure Relief Valve Spring
(6) Oil Pressure Relief Valve Bore Plug
(7) Oil Pressure Relief Valve Bore Plug Retainer Clip
(8) Oil Pump Driven Gear
(9) Oil Pump Drive Gear
(10) Oil Pump Cover
(11) Primary Camshaft Drive Chain Lower Guide
(12) Primary Camshaft Drive Chain Lower Guide Retaining Bolt

© 2010 General Motors Corporation. All rights reserved.

Engine Block Assembly

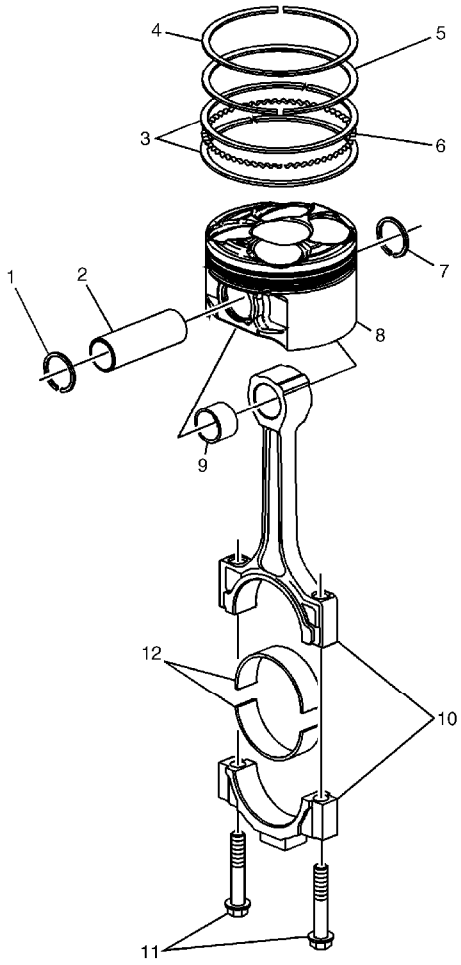


(1) Crankshaft Sprocket Pin
(2) Crankshaft Lower Bearing
(3) Crankshaft Bearing Cap
(4) Crankshaft Bearing Cap Outboard Bolt
(5) Crankshaft Bearing Cap Inboard Bolt
(6) Crankshaft Bearing Thrust Cap
(7) Oil Jet Retaining Bolt
(8) Oil Jet
(9) Crankshaft Upper Thrust Bearing #3
(10) Cylinder Block-to-Oil Pan Alignment Dowels
(11) Crankshaft Bearing Cap Side Bolt - Long

© 2010 General Motors Corporation. All rights reserved.

(12) Engine Block Oil Gallery Threaded Plug - 14 mm
(13) Crankshaft Rear Oil Seal Housing Assembly
(14) Crankshaft Rear Oil Seal Housing Assembly Bolt
(15) Cylinder Block-to-Transmission Alignment Dowels
(16) Engine Block Coolant Drain Threaded Plug - 14 mm
(17) Piston and Connecting Rod Assembly
(18) Engine Block Oil Gallery Threaded Plug - 14 mm
(19) Engine Block Core Coolant Expansion Plug - 34.3 mm
(20) Cylinder Head Locating Pin
(21) Engine Block
(22) Engine Block Oil Gallery Expansion Plug - 14 mm
(23) Engine Block Oil Gallery Threaded Plug - 20 mm
(24) Engine Block Oil Gallery Expansion Plug - 10 mm
(25) Crankshaft Bearing Cap Side Bolt - Short
(26) Crankshaft Upper Bearing
(27) Crankshaft

Piston, Rings, Bearing and Connecting Rod

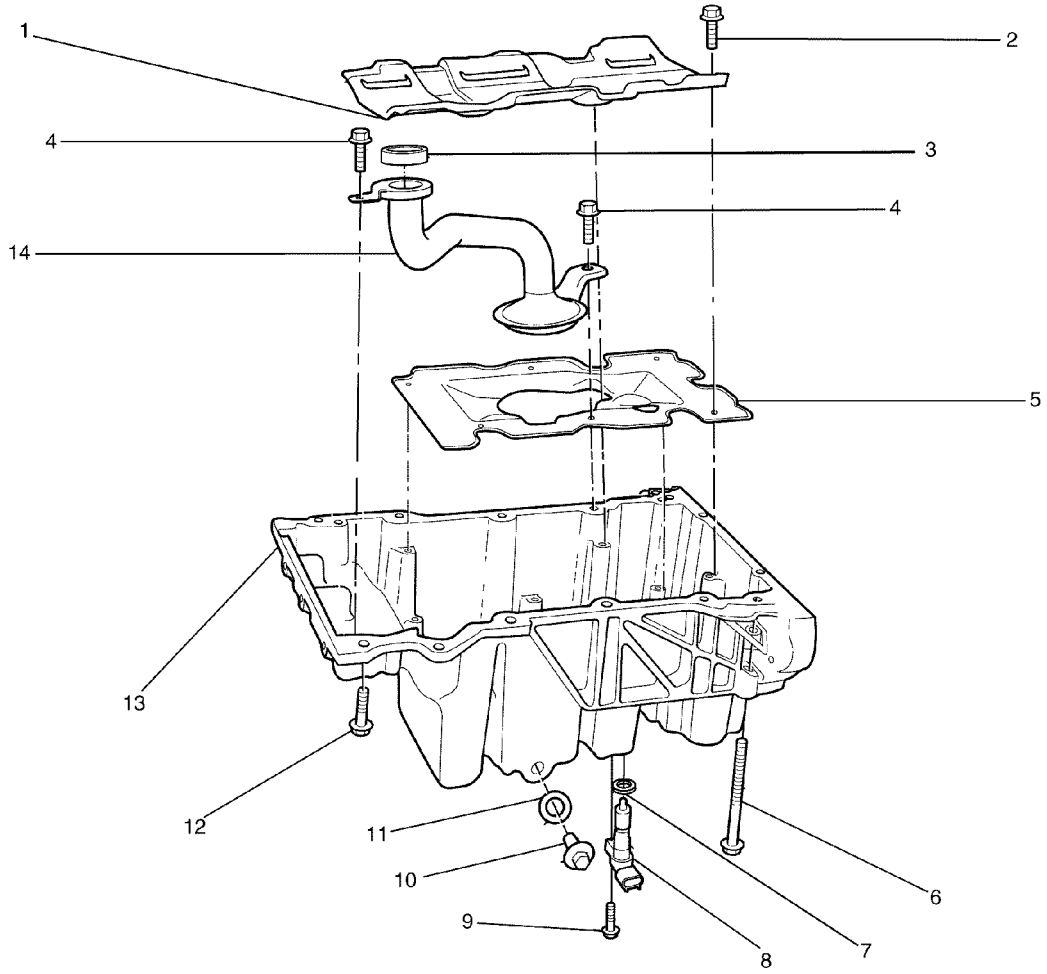


(1) Piston Pin Retainer
(2) Piston Pin
(3) Piston Oil Control Rail Ring
(4) Piston Upper Compression Ring
(5) Piston Lower Compression Ring
(6) Piston Oil Control Ring Spacer
(7) Piston Pin Retainer
(8) Piston
(9) Connecting Rod Bushing
(10) Connecting Rod
(11) Connecting Rod Bolt

© 2010 General Motors Corporation. All rights reserved.

(12) Connecting Rod Bearing

Oil Pan Assembly

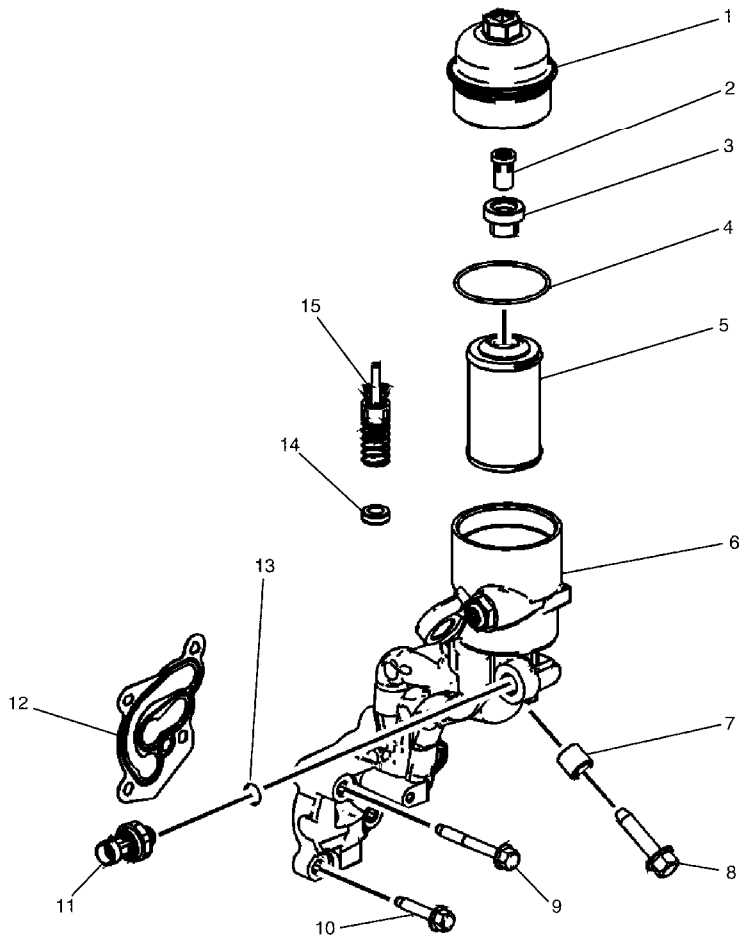


(1) Oil Pan Baffle Scraper
(2) Oil Pan Scraper to Oil Pan Retaining Bolt
(3) Oil Pump Suction Pipe Seal
(4) Oil Suction Pipe to Oil Pan Retaining Bolt
(5) Oil Pan Baffle
(6) Oil Pan Bolt - Long
(7) Engine Oil Level Sensor O-Ring
(8) Engine Oil Level Sensor
(9) Engine Oil Level Sensor Bolt
(10) Oil Pan Drain Plug
(11) Oil Pan Drain Plug O-Ring

© 2010 General Motors Corporation. All rights reserved.

(12) Oil Pan Bolt - Short
(13) Oil Pan
(14) Oil Pump Suction Pipe

Oil Filter Adapter

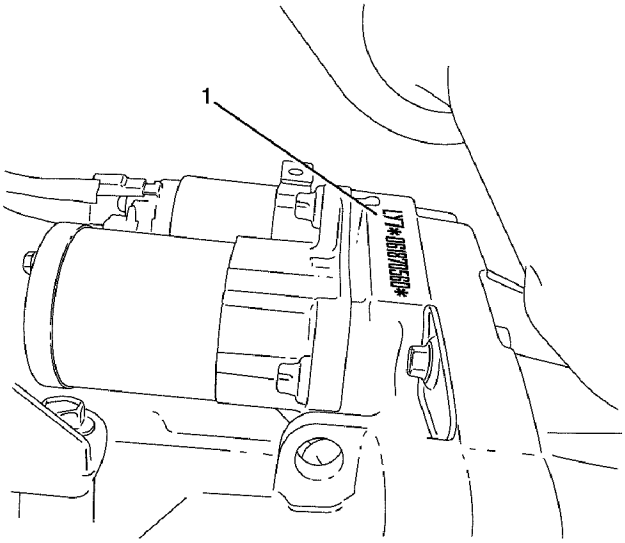


(1) Oil Filter AdapterCap
(2) Oil Filter Bypass Valve
(3) Drain Valve Assembly
(4) Oil Filter Cap O-ring
(5) Oil Filter Cartridge
(6) Oil Filter Adapter
(7) Oil Filter Adapter Bolt Sleeve
(8) Oil Filter Adapter Bolt - Large
(9) Oil Filter Adapter Bolt - Long
(10) Oil Filter Adapter Bolt
(11) Engine Oil Pressure Sensor

© 2010 General Motors Corporation. All rights reserved.

(12) Oil Filter Adapter Gasket
(13) Engine Oil Pressure Sensor O-ring
(14) Drain Valve Assembly Seal
(15) Oil Filter Bypass Valve Body

Engine Identification



Important: The location of the Engine Serial Number has changed from the previous model. The vehicle must be raised to view the Engine Serial Number as it can only be seen from underneath the vehicle.

The Engine Serial Number is located on the left-hand side at the rear of the engine cylinder block (1) and is stamped or laser etched onto the block at the assembly plant. When reading the Engine Serial Number the following information can be obtained:

Engine Serial Number LY7*061870560* is used as an example:

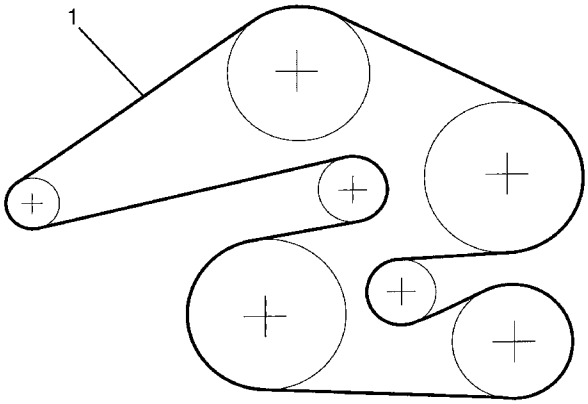
- The first three digits, LY7, identify the engine model by its Regular Production Option (RPO) code as an LY7 engine.
- The next digit, *, is a number limiter and has no meaning.
- The next two digits, 06, identify the build year as 2006.
- The next three digits, 187, identify the Julian date the engine was manufactured as day 187.
- The next four digits, 0560, identify the assembly plant sequence number as 0560.
- The next digit, *, is a number limiter and has no meaning.

© 2010 General Motors Corporation. All rights reserved.

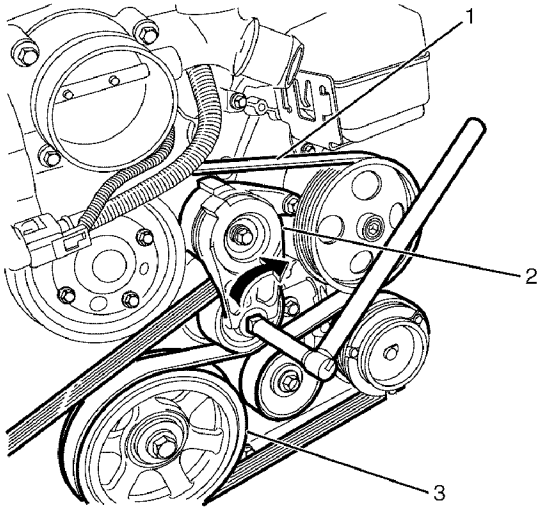
Drive Belt Replacement

Removal Procedure

1. Remove the air intake duct. Refer to Air Cleaner Inlet Duct Replacement .



2. Note the routing of the drive belt (1).



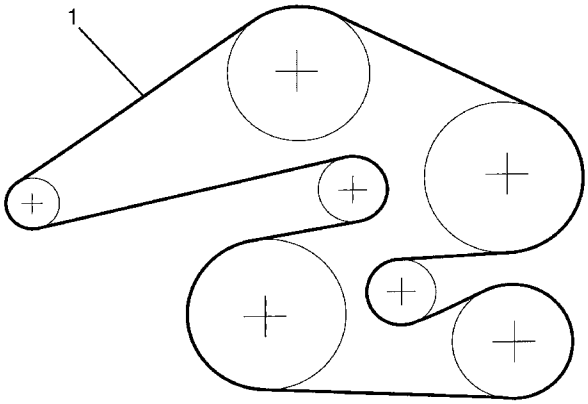
Important: Using a suitable tool rotate the drive belt tensioner (2) clockwise.

3. Rotate the drive belt tensioner (2) clockwise in order to release tension on the drive belt (1).

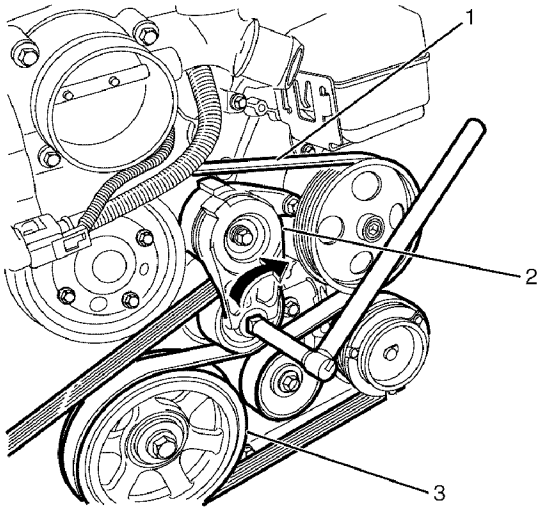
© 2010 General Motors Corporation. All rights reserved.

4. Remove the drive belt (1) from the crankshaft pulley (3).
5. Slowly release the drive belt tensioner (2).
6. Remove the drive belt (1).

Installation Procedure



1. Install and correctly route the drive belt (1) around the following:
   - Water pump pulley
   - Generator
   - Drive belt tensioner
   - Crankshaft balancer
   - Air conditioning compressor
   - Power steering pump



2. Using a suitable tool rotate the drive belt tensioner (2) clockwise.
3. Install the drive belt (1) to the crankshaft pulley (3).

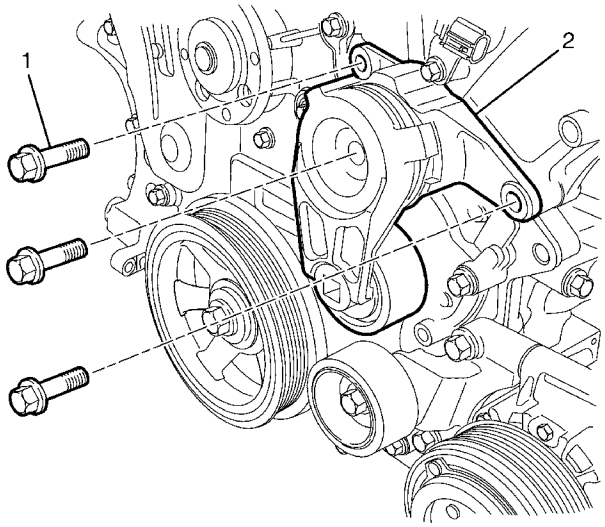
Important: Make sure the drive belt (1) is correctly aligned and seated into the grooves of the accessory drive pulleys.

4. Slowly release the drive belt tensioner (2).
5. Remove the suitable tool from the drive belt tensioner (2).
6. Install the air intake duct. Refer to Air Cleaner Inlet Duct Replacement .

Drive Belt Tensioner Replacement

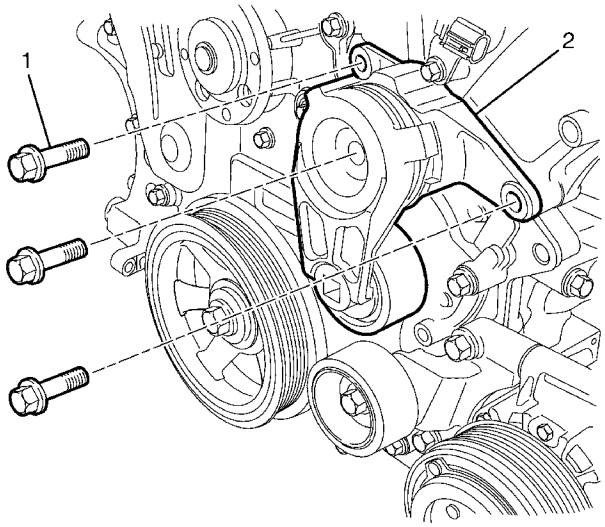
Removal Procedure

1. Remove the air intake duct. Refer to Air Cleaner Inlet Duct Replacement.
2. Remove the drive belt. Refer to Drive Belt Replacement.



3. Remove the drive belt tensioner to engine front cover retaining bolts (1).
4. Remove the drive belt tensioner (2).

Installation Procedure



© 2010 General Motors Corporation. All rights reserved.

1. Install the drive belt tensioner (2) to the engine front cover.

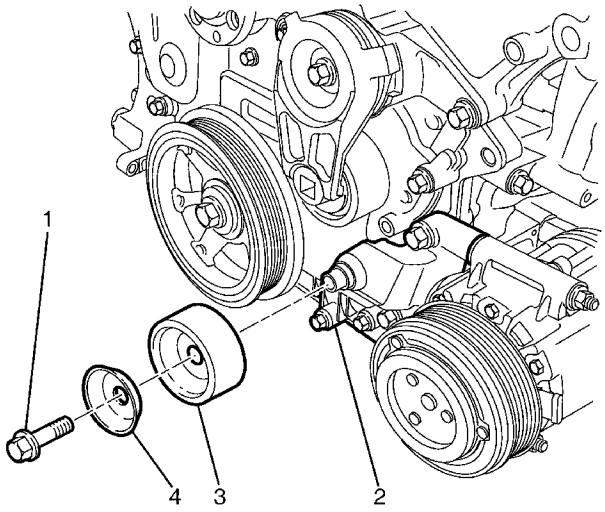
   Caution: Refer to Fastener Caution in the Preface section.

2. Install the drive belt tensioner to the engine front cover retaining bolts (1) and tighten to **22 N·m (17 lb ft)**.
3. Install the drive belt. Refer to Drive Belt Replacement.
4. Install the air intake duct. Refer to Air Cleaner Inlet Duct Replacement.

Drive Belt Idler Pulley Replacement

Removal Procedure

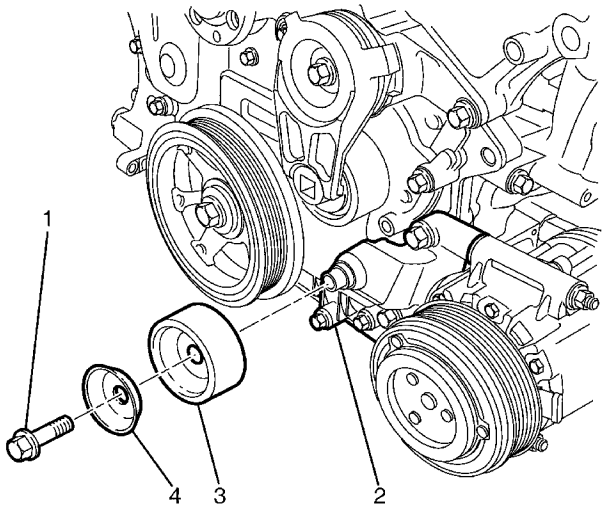
1. Remove the air intake duct. Refer to Air Cleaner Inlet Duct Replacement.
2. Remove the drive belt. Refer to Drive Belt Replacement.



3. Remove the drive belt idler pulley to accessory drive mounting bracket retaining bolt (1).
4. Remove the dished washer (4) and drive belt idler pulley (3) from the accessory drive mounting bracket (2).

Installation Procedure

© 2010 General Motors Corporation. All rights reserved.



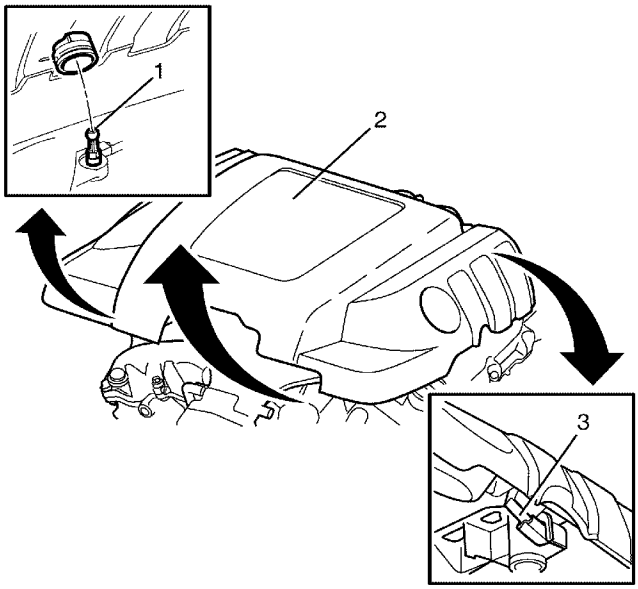
1. Install the dished washer (4) and drive belt idler pulley (3) to the accessory drive mounting bracket (2).
2. Hand tighten the drive belt idler pulley to accessory drive mounting bracket retaining bolt (1).

Caution: Refer to Fastener Caution in the Preface section.

3. Install the drive belt idler pulley with the accessory drive mounting bracket retaining bolt and tighten to **58 N·m (43 lb ft)**.
4. Install the drive belt. Refer to Drive Belt Replacement.
5. Install the air intake duct. Refer to Air Cleaner Inlet Duct Replacement.

Engine Cover Replacement

Removal Procedure

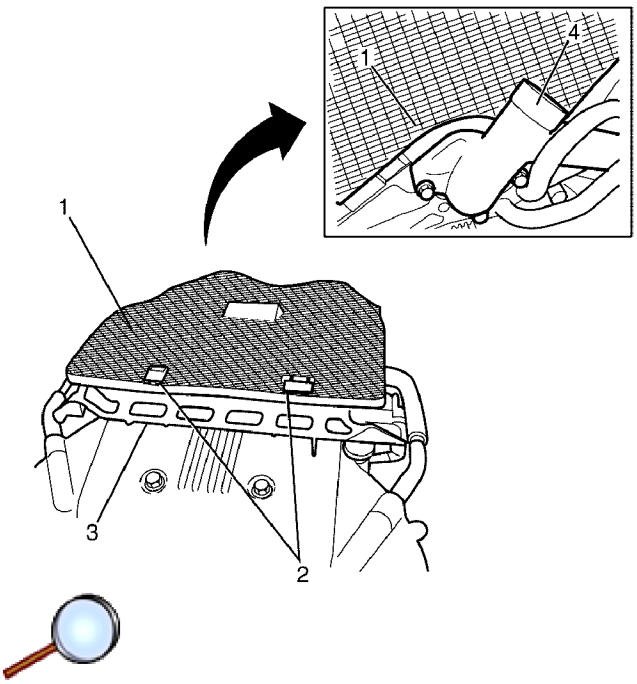


Note: Apply suitable pressure on the front edge of the engine cover (2) to disengage the locator legs (1).

Note: Disengage the engine cover insulator legs (1) by raising the engine cover (2) upwards and moving it suitably forward to release the retention hooks (3).

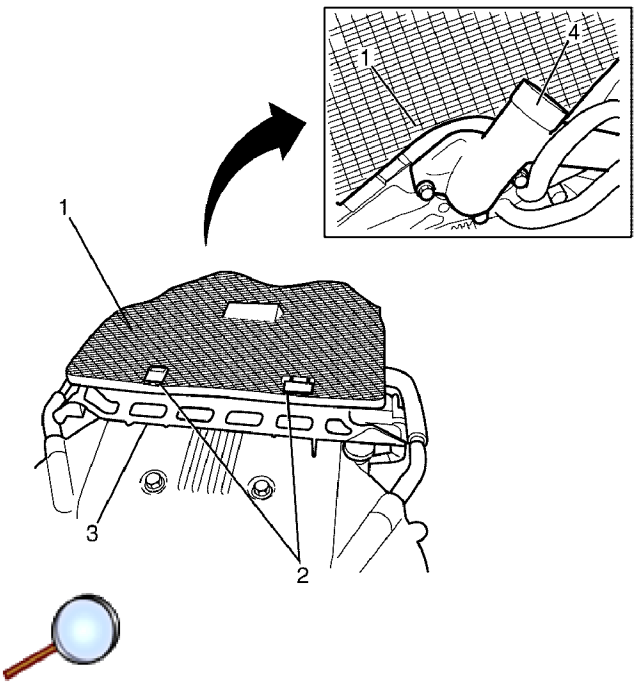
1. Remove the engine cover (2).

© 2010 General Motors Corporation. All rights reserved.



2. Disengage the sound insulator (1) from the two hooks (2) on the intake manifold sight shield bracket (3).
3. Remove the sound insulator (1) ensuring it safely releases from behind the water outlet housing (4).

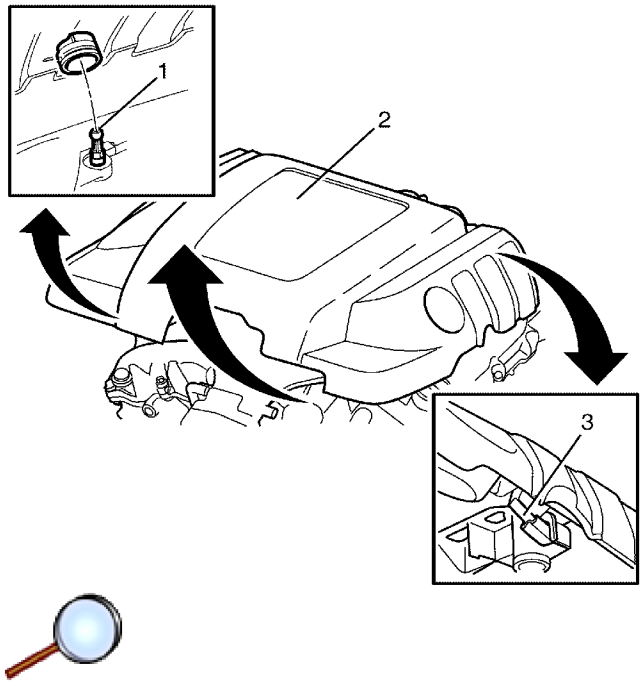
Installation Procedure



Note: Make sure the sound insulator (1) correctly locates behind the water outlet housing (4).

1. Install the sound insulator (1).

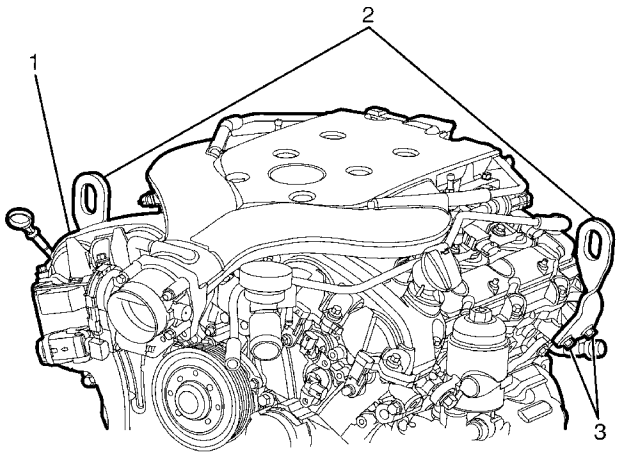
2. Engage the sound insulator (1) onto the two retention hooks (2) on the intake manifold sight shield bracket (3).



Note: When installing the engine cover (2) onto the engine assembly, make sure to correctly engage the retention hooks (3).

3. Install the engine cover (2) onto the engine assembly, engaging the engine cover insulator legs (1).

Engine Mount Inspection



1. Position the EN 46114 (2) on the engine (1).

   Caution: Refer to Fastener Caution in the Preface section.

2. Install the EN 46114 to cylinder head retaining bolts (3) and tighten to **50 N·m (36 lb ft)**.

   Caution: Broken or deteriorated mounts can cause misalignment and destruction of certain drive train components. When a single mount breaks, the remaining mounts are subjected to abnormally high stresses.

   Note: Raising the engine, will remove the weight from the engine mount and create a slight tension in the rubber mount.

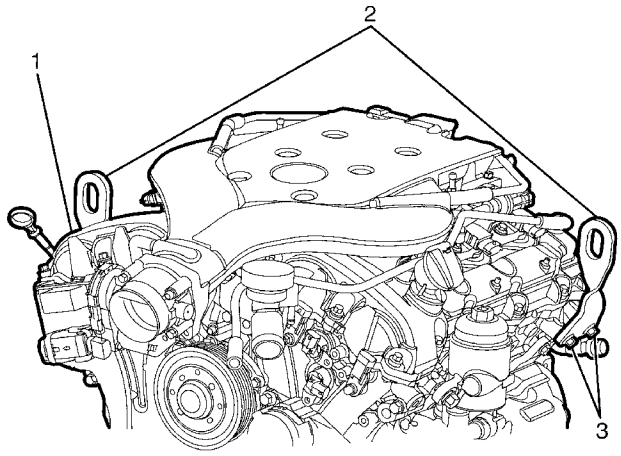
3. Use a suitable engine lifting tool to raise the engine until the weight of the engine is removed from the engine mounts.

   Note: Before replacing any engine mount due to suspected fluid loss, verify that the source of the fluid is actually the engine mount, not the engine or other accessories.

4. Observe the engine mount while raising the engine. Replace the engine mount if the mount exhibits any of the following conditions:
   - The hard rubber surface is covered with heat check cracks.
   - The rubber is separated from the metal plate of the engine mount.
   - The rubber is split through the center of the engine mount.
   - The GLYCOL™ fluid is leaking from the engine mount.
5. If there is movement between the metal plate of the engine mount and its attaching points,

© 2010 General Motors Corporation. All rights reserved.

lower the engine on the engine mount. Tighten the bolts or nuts attaching the engine mount to the frame or engine mount bracket. Refer to Engine Mount Replacement - Left Side or Engine Mount Replacement - Right Side.



6. Remove the EN 46114 to cylinder head retaining bolts (3).
7. Remove the EN 46114 (2) from the engine (1).

Engine Mount Replacement - Left Side

Removal Procedure

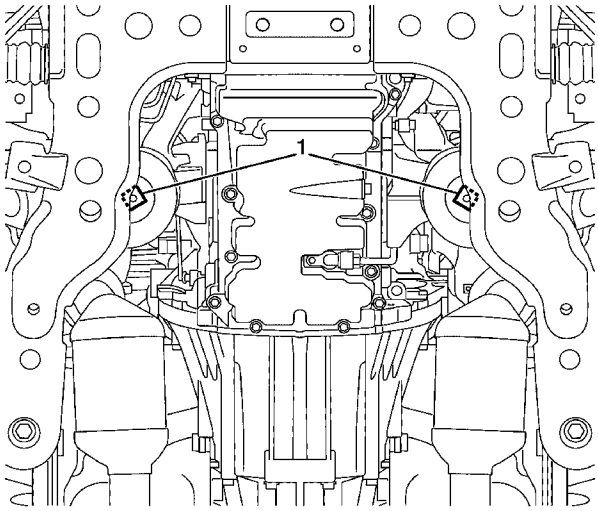
Special Tools

EN 46114 Engine Lift Brackets.

Warning: Refer to Safety Glasses Warning in the Preface section.

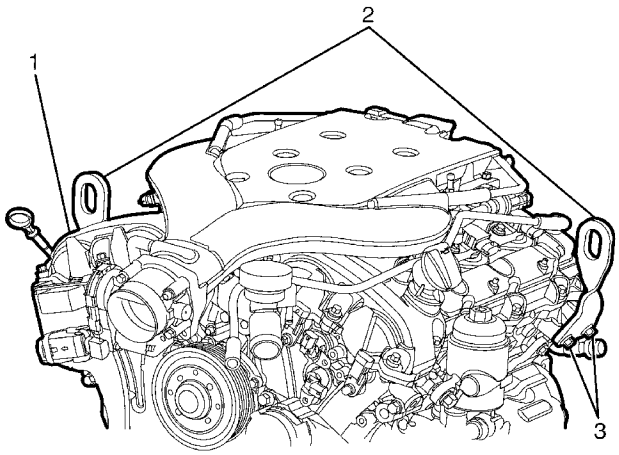
Danger: To avoid any vehicle damage, serious personal injury or death when major components are removed from the vehicle and the vehicle is supported by a hoist, support the vehicle with jack stands at the opposite end from which the components are being removed and strap the vehicle to the hoist.

1. Raise and support the vehicle. Refer to Lifting and Jacking the Vehicle.
2. Remove the engine splash shield. Refer to Engine Splash Shield Replacement.



3. Remove the engine mount to front subframe retaining nuts (1).
4. Lower the vehicle.

© 2010 General Motors Corporation. All rights reserved.



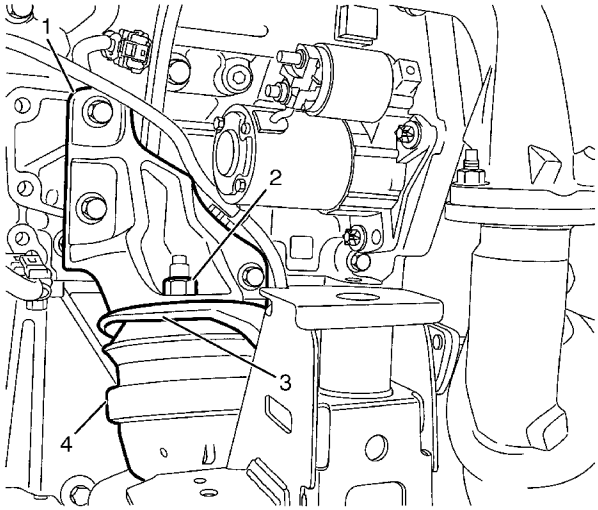
5. Position the EN 46114 (2) on the engine (1).

Caution: Refer to Fastener Caution in the Preface section.

6. Install the EN 46114 using the cylinder head retaining bolts (3) and tighten to **50 N·m (36 lb ft)**.

Note: When lifting the engine assembly, observe the clearance between the rear of the engine assembly and the dash panel.

7. Use a suitable engine lifting tool to raise the engine until the weight of the engine is removed from the left hand engine mount.



8. Remove the left hand engine mount to engine mount bracket retaining nut (2).

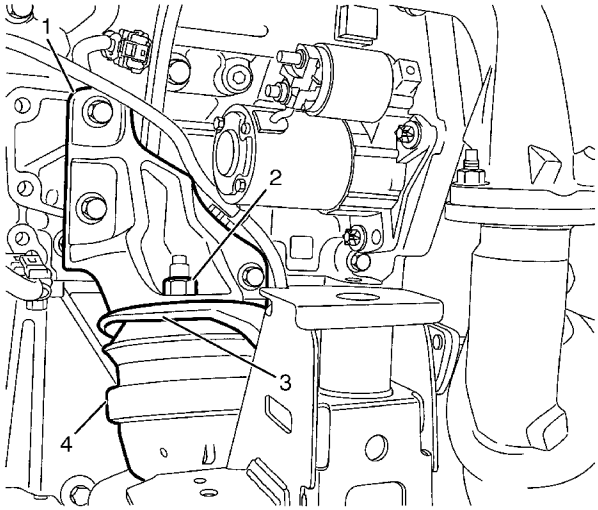
Note: If required raise the engine further to provide adequate space.

Note: When lifting the engine assembly, observe the clearance between the rear of the engine assembly and the dash panel.

Note: DO NOT distort or bend the left hand engine mount heat shield (3).

9. Remove the left hand engine mount (4) from the left hand engine mount bracket (1).

Installation Procedure



Note: DO NOT distort or bend the left hand engine mount heat shield (3).

1. Position the left hand engine mount (4) on the left hand engine mount bracket (1).

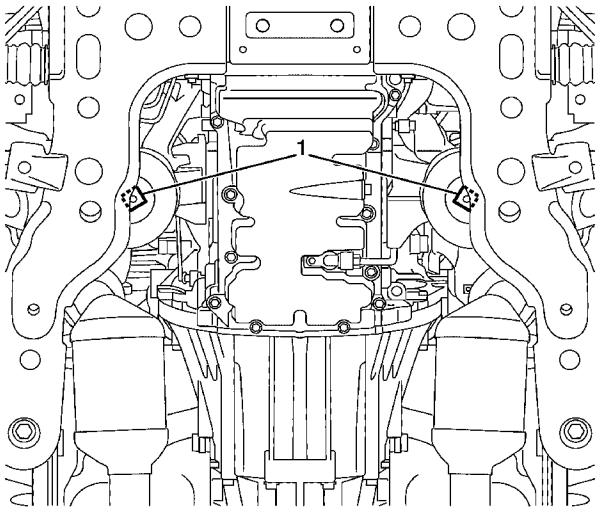
Caution: Refer to Fastener Caution in the Preface section.

2. Install the left hand engine mount using the engine mount bracket retaining nut (2) and tighten to **80 N·m (59 lb ft)**.
3. Lower the engine until the weight is resting on the left hand engine mount.

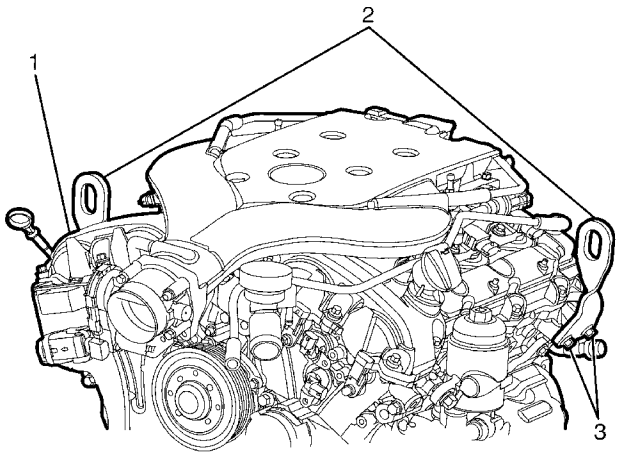
Warning: Refer to Safety Glasses Warning in the Preface section.

Danger: To avoid any vehicle damage, serious personal injury or death when major components are removed from the vehicle and the vehicle is supported by a hoist, support the vehicle with jack stands at the opposite end from which the components are being removed and strap the vehicle to the hoist.

4. Raise the vehicle.



5. Install the engine mount using the front subframe retaining nuts (1) and tighten to **80 N·m (59 lb ft)**.
6. Install the engine splash shield. Refer to Engine Splash Shield Replacement.
7. Lower the vehicle to the ground.



8. Remove the EN 46114 to cylinder head retaining bolts (3).
9. Remove the EN 46114 (2) from the engine (1).

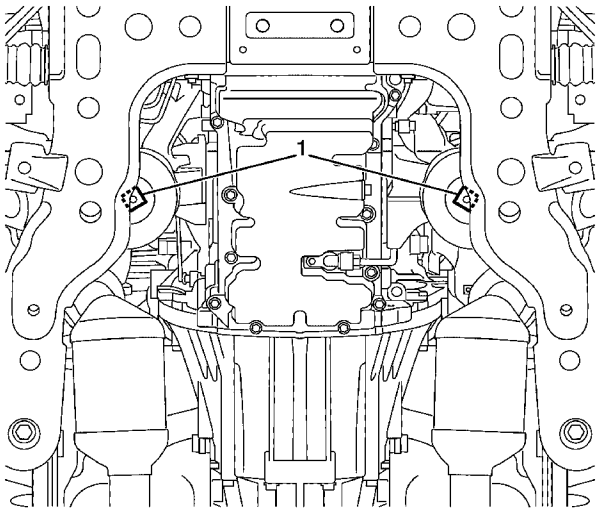
Engine Mount Replacement - Right Side

Removal Procedure

Warning: Refer to Safety Glasses Warning in the Preface section.

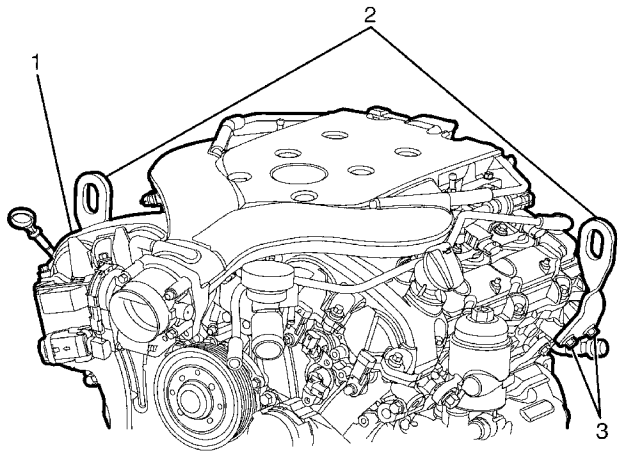
Danger: To avoid any vehicle damage, serious personal injury or death when major components are removed from the vehicle and the vehicle is supported by a hoist, support the vehicle with jack stands at the opposite end from which the components are being removed and strap the vehicle to the hoist.

1. Raise and support the vehicle. Refer to Lifting and Jacking the Vehicle.
2. Remove the engine splash shield. Refer to Engine Splash Shield Replacement.



3. Remove the engine mount to front subframe retaining nuts (1).
4. Lower the vehicle.

© 2010 General Motors Corporation. All rights reserved.



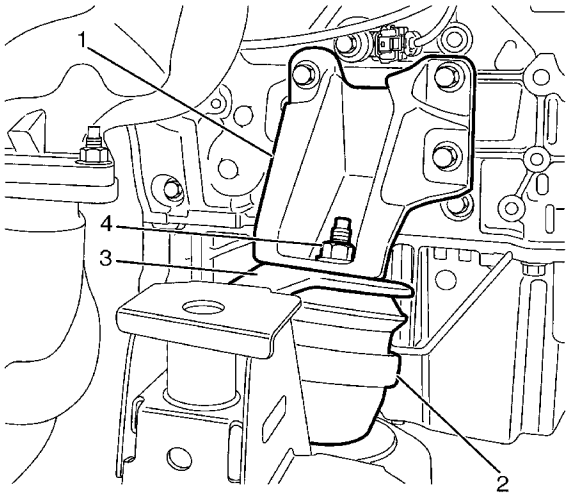
5. Position the EN 46114 (2) on the engine (1).

Caution: Refer to Fastener Caution in the Preface section.

6. Install the EN 46114 using the cylinder head retaining bolts (3) and tighten to **50 N·m (36 lb ft)**.

Note: When lifting the engine assembly, observe the clearance between the rear of the engine assembly and the dash panel.

7. Use a suitable engine lifting tool to raise the engine until the weight of the engine is removed from the right hand engine mount.



8. Remove the right hand engine mount to engine mount bracket retaining nut (4).

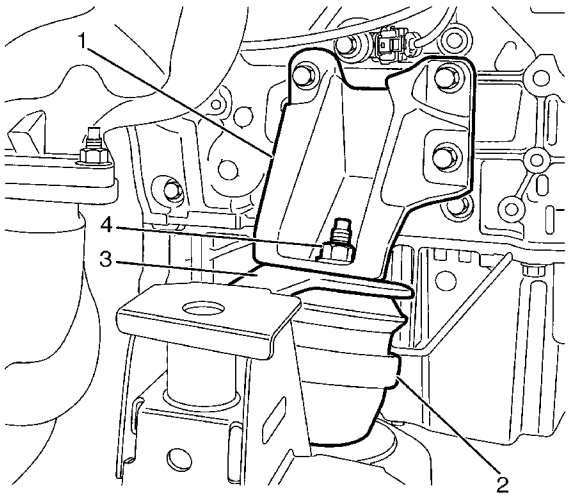
Note: If required raise the engine further to provide adequate space.

Note: When lifting the engine assembly, observe the clearance between the rear of the engine assembly and the dash panel.

Note: DO NOT distort or bend the right hand engine mount heat shield (3).

9. Remove the right hand engine mount (2) from the right hand engine mount bracket (1).

Installation Procedure



Note: DO NOT distort or bend the right hand engine mount heat shield (3).

1. Position the right hand engine mount (2) on the right hand engine mount bracket (1).

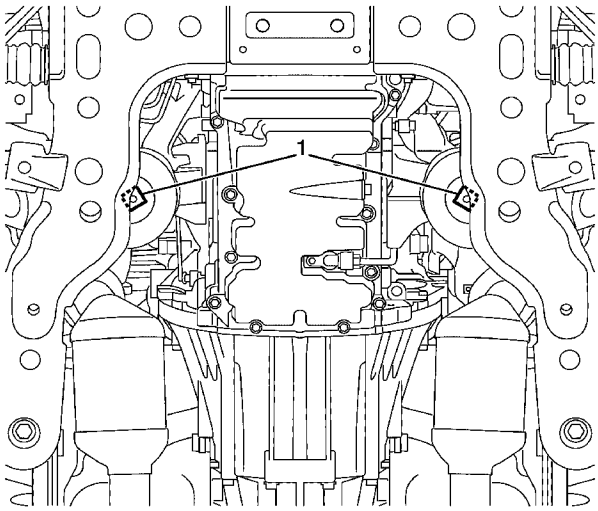
Caution: Refer to Fastener Caution in the Preface section.

2. Install the right hand engine mount using the engine mount bracket retaining nut (4) and tighten to **80 N·m (59 lb ft)**.
3. Lower the engine until the weight is resting on the right hand engine mount.

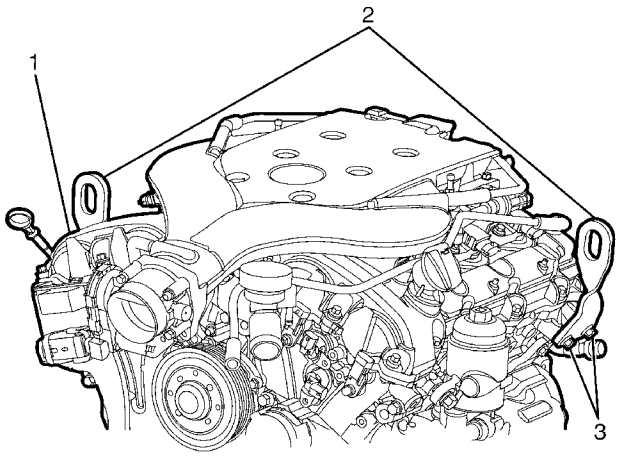
Warning: Refer to Safety Glasses Warning in the Preface section.

Danger: To avoid any vehicle damage, serious personal injury or death when major components are removed from the vehicle and the vehicle is supported by a hoist, support the vehicle with jack stands at the opposite end from which the components are being removed and strap the vehicle to the hoist.

4. Raise the vehicle.



5. Install the engine mount using the front subframe retaining nuts (1) and tighten to **80 N·m (59 lb ft)**.
6. Install the engine splash shield. Refer to Engine Splash Shield Replacement.
7. Lower the vehicle to the ground.



8. Remove the EN 46114 to cylinder head retaining bolts (3).
9. Remove the EN 46114 (2) from the engine (1).

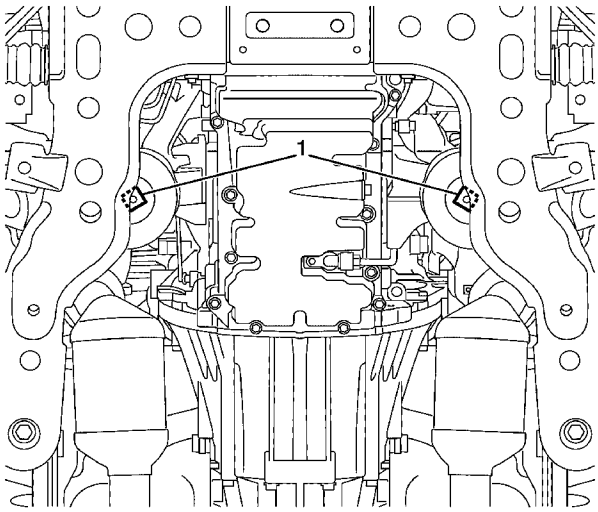
Engine Mount Bracket Replacement - Left Side

Removal Procedure

Warning: Refer to Safety Glasses Warning in the Preface section.

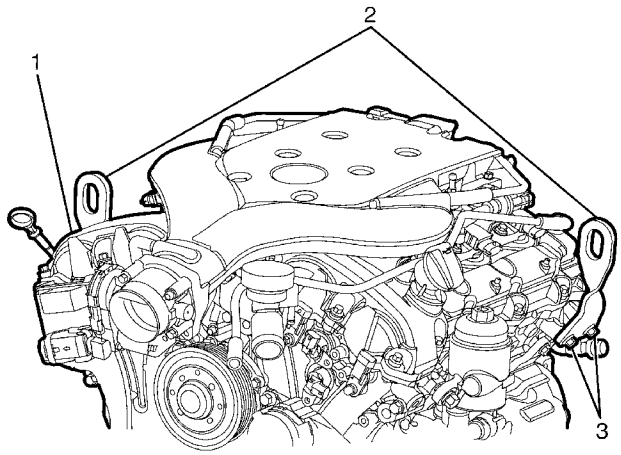
Danger: To avoid any vehicle damage, serious personal injury or death when major components are removed from the vehicle and the vehicle is supported by a hoist, support the vehicle with jack stands at the opposite end from which the components are being removed and strap the vehicle to the hoist.

1. Raise and support the vehicle. Refer to Lifting and Jacking the Vehicle.
2. Remove the engine splash shield. Refer to Engine Splash Shield Replacement.



3. Remove the lower engine mount retaining nuts (1).
4. Lower the vehicle.

© 2010 General Motors Corporation. All rights reserved.



5. Position the EN 46114 (2) on the engine (1).

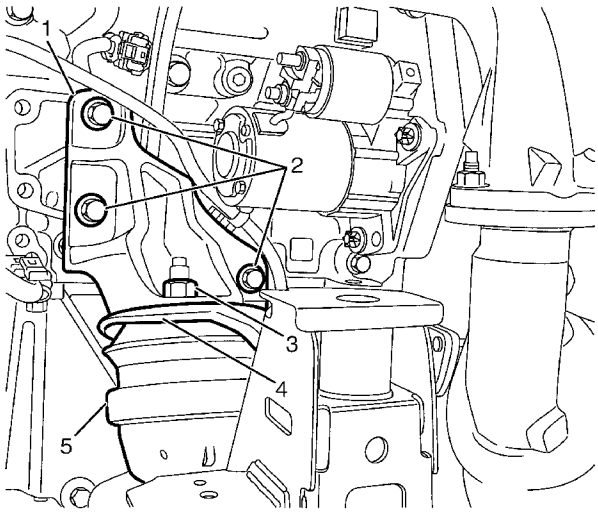
Caution: Refer to Fastener Caution in the Preface section.

6. Install the EN 46114 using the cylinder head retaining bolts (3) and tighten to **50 N·m (36 lb ft)**.

Note: Use a suitable tool to raise the engine.

Note: When lifting the engine assembly, observe the clearance between the rear of the engine assembly and the dash panel.

7. Raise the engine until the weight of the engine is removed from the left hand engine mount.



8. Remove the left hand engine mount to engine mount bracket retaining nut (3).

   Note: If required raise the engine further to provide adequate space.

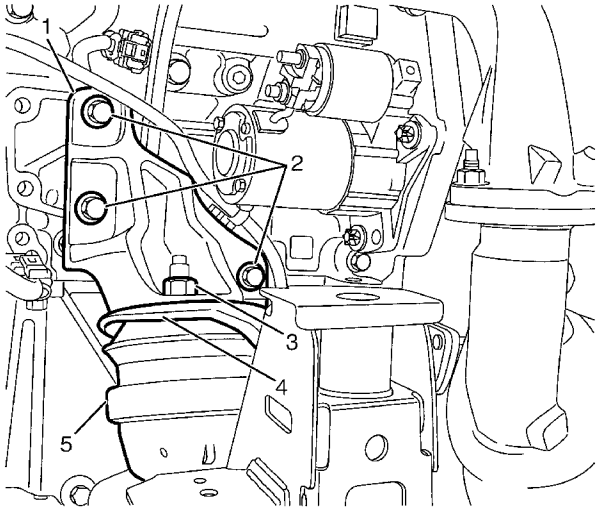
   Note: When lifting the engine assembly, observe the clearance between the rear of the engine assembly and the dash panel.

9. Remove the left hand engine mount (5) from the left hand engine mount bracket (1).

   Note: DO NOT distort or bend the left hand engine mount heat shield (4).

10. Remove the left hand engine mount bracket to cylinder block retaining bolts (2).
11. Remove the left hand engine mount bracket (1).

Installation Procedure



Note: DO NOT distort or bend the left hand engine mount heat shield (4).

1. Install the left hand engine mount bracket (1).

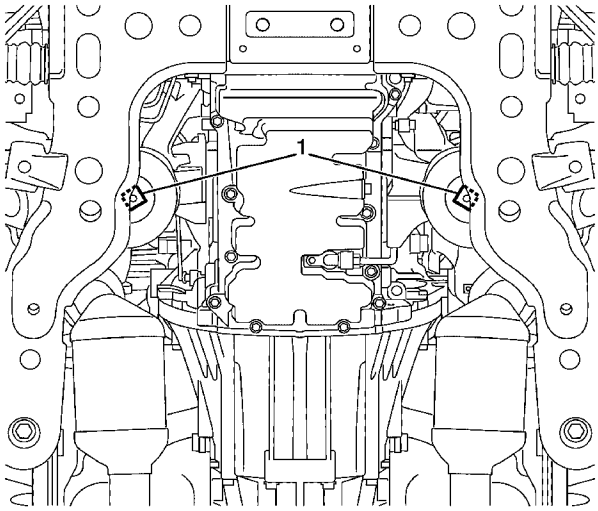
   Caution: Refer to Fastener Caution in the Preface section.

2. Install the left hand engine mount bracket using the cylinder block retaining bolts (2) and tighten to **60 N·m (44 lb ft)**.
3. Position the left hand engine mount (5) on the left hand engine mount bracket (1).
4. Install the left hand engine mount using the engine mount bracket retaining nut (3) and tighten to **80 N·m (59 lb ft)**.
5. Lower the engine until the weight is resting on the left hand engine mount.

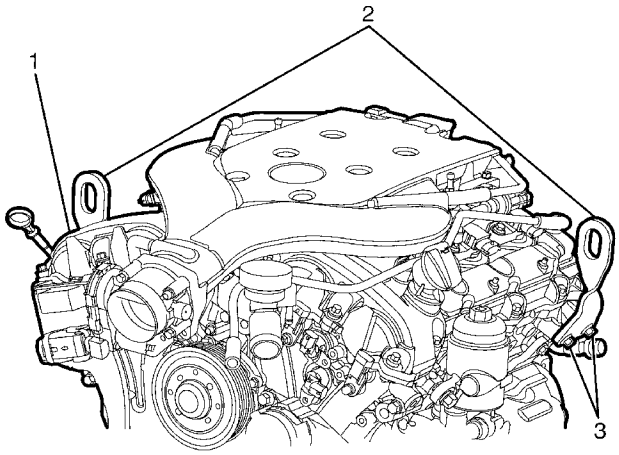
   Warning: Refer to Safety Glasses Warning in the Preface section.

Danger: To avoid any vehicle damage, serious personal injury or death when major components are removed from the vehicle and the vehicle is supported by a hoist, support the vehicle with jack stands at the opposite end from which the components are being removed and strap the vehicle to the hoist.

6. Raise the vehicle.



7. Install the engine mount using the front subframe retaining nut (1) and tighten to **80 N·m (59 lb ft)**.
8. Install the engine splash shield. Refer to Engine Splash Shield Replacement.
9. Lower the vehicle to the ground.



10. Remove the EN 46114 to cylinder head retaining bolts (3).
11. Remove the EN 46114 (2) from the engine (1).

Engine Mount Bracket Replacement - Right Side

Removal Procedure

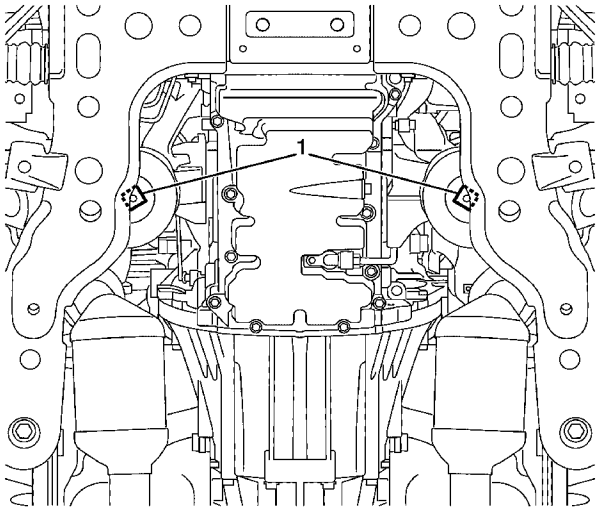
Special Tools

EN 46114 Engine Lift Brackets.

Warning: Refer to Safety Glasses Warning in the Preface section.

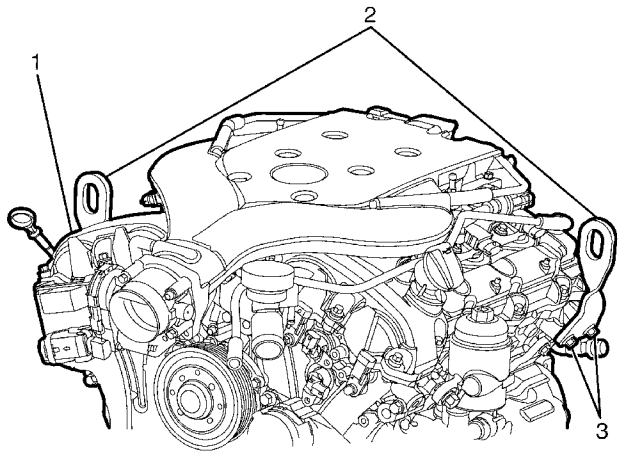
Danger: To avoid any vehicle damage, serious personal injury or death when major components are removed from the vehicle and the vehicle is supported by a hoist, support the vehicle with jack stands at the opposite end from which the components are being removed and strap the vehicle to the hoist.

1. Raise and support the vehicle. Refer to Lifting and Jacking the Vehicle.
2. Remove the engine splash shield. Refer to Engine Splash Shield Replacement.



3. Remove the lower engine mount retaining nuts (1).
4. Lower the vehicle.

© 2010 General Motors Corporation. All rights reserved.



5. Position the EN 46114 (2) on the engine (1).

   Caution: Refer to Fastener Caution in the Preface section.

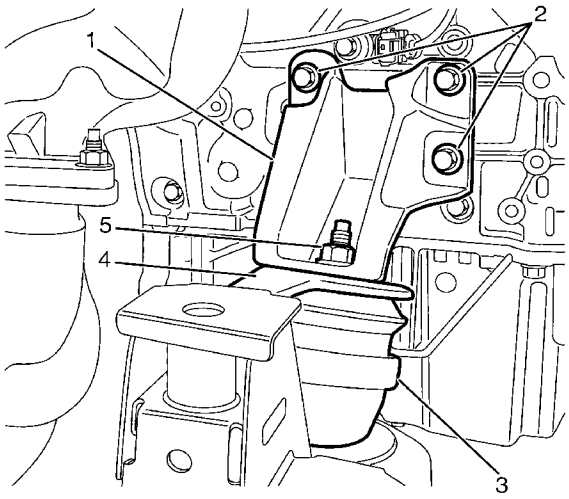
6. Install the EN 46114 to cylinder head retaining bolts (3) and tighten to **50 N·m (36 lb ft)**.

   Tighten
   Tighten the bolts to.

   Note: Use a suitable tool to raise the engine.

   Note: When lifting the engine assembly, observe the clearance between the rear of the engine assembly and the dash panel.

7. Raise the engine until the weight of the engine is removed from the right hand engine mount.



8. Remove the right hand engine mount to engine mount bracket retaining nut (5).

   Note: If required raise the engine further to provide adequate space.

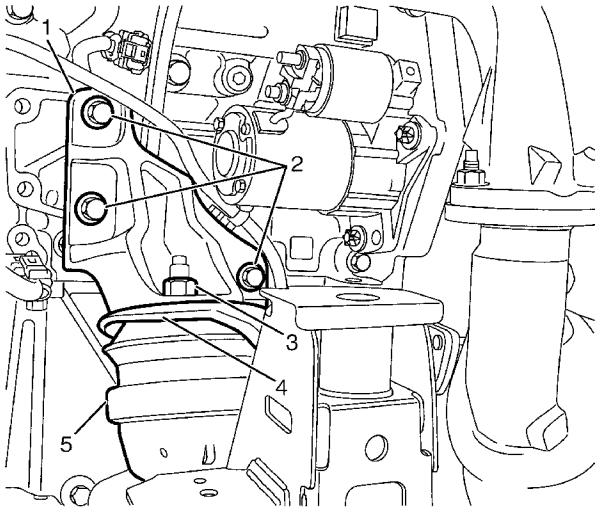
   Note: When lifting the engine assembly, observe the clearance between the rear of the engine assembly and the dash panel.

9. Remove the right hand engine mount (3) from the right hand engine mount bracket (1).

   Note: DO NOT distort or bend the right hand engine mount heat shield (4).

10. Remove the right hand engine mount bracket to cylinder block retaining bolts (2).
11. Remove the right hand engine mount bracket (1).

Installation Procedure



Important: DO NOT distort or bend the right hand engine mount heat shield (4).

1. Install the right hand engine mount bracket (1).

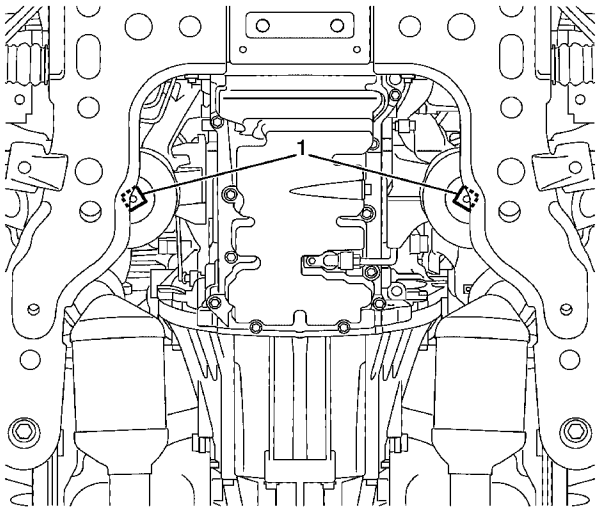
Caution: Refer to Fastener Caution in the Preface section.

2. Install the right hand engine mount bracket using the cylinder block retaining bolts (2) and tighten to **60 N·m (44 lb ft)**.
3. Position the right hand engine mount (3) on the right hand engine mount bracket (1).
4. Install the right hand engine mount using the engine mount bracket retaining nut (5) and tighten to **80 N·m (59 lb ft)**.
5. Lower the engine until the weight is resting on the right hand engine mount.

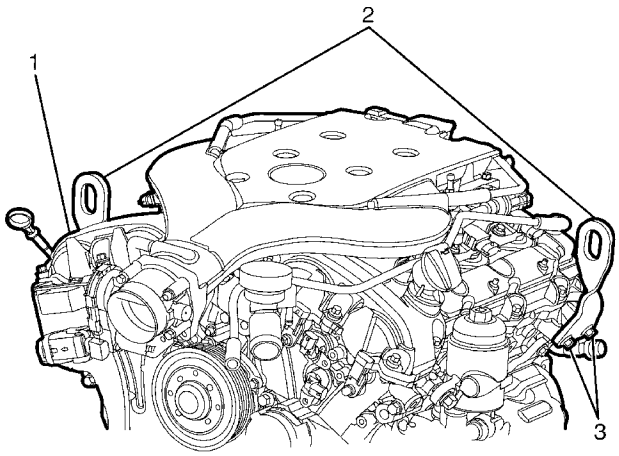
Warning: Refer to Safety Glasses Warning in the Preface section.

Danger: To avoid any vehicle damage, serious personal injury or death when major components are removed from the vehicle and the vehicle is supported by a hoist, support the vehicle with jack stands at the opposite end from which the components are being removed and strap the vehicle to the hoist.

6. Raise the vehicle.



7. Install the engine mount using the front subframe retaining nut (1) and tighten to **80 N·m (59 lb ft)**.
8. Install the engine splash shield. Refer to Engine Splash Shield Replacement.
9. Lower the vehicle to the ground.

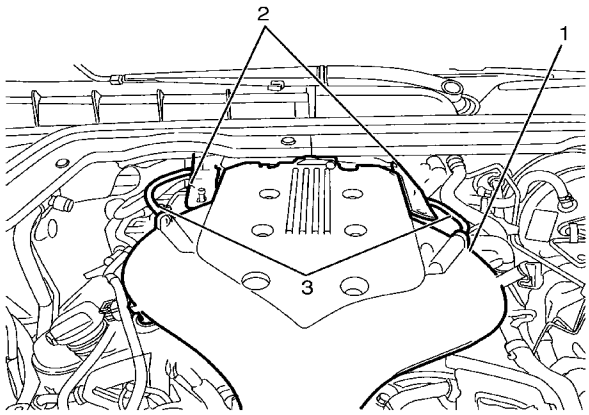


10. Remove the EN 46114 to cylinder head retaining bolts (3).
11. Remove the EN 46114 (2) from the engine (1).

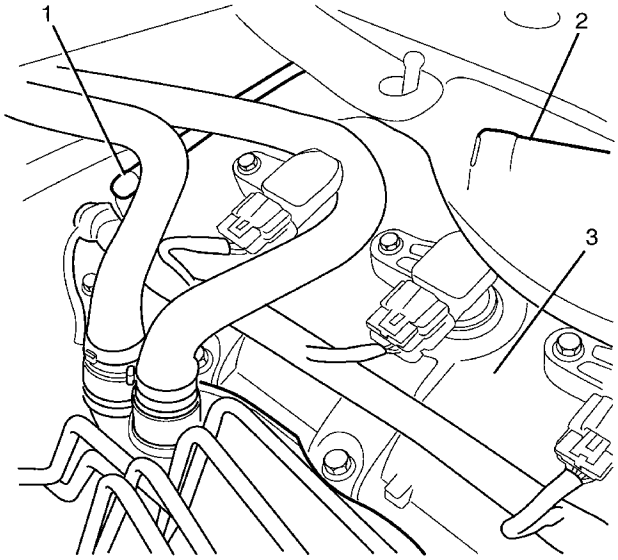
Positive Crankcase Ventilation Hose / Pipe / Tube Replacement

Removal Procedure

1. Remove the engine covers. Refer to Engine Cover Replacement.



2. Detach and reposition the noise insulation panel (3) from the engine cover ball studs on the intake manifold assembly (1).
3. Disconnect the PCV tube (2) from both sides of the upper intake manifold assembly (1).

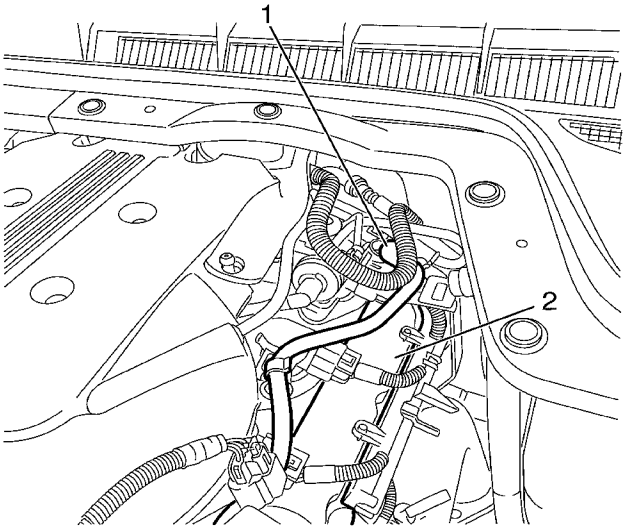


© 2010 General Motors Corporation. All rights reserved.

4. Disconnect the PCV tube (1) from the right camshaft cover (3).

Important: Install a rubber cap or plug to the right hand camshaft cover (3) to prevent dust and dirt entry.

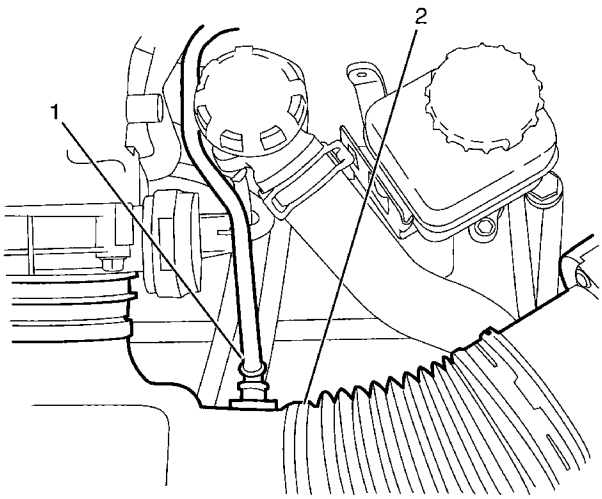
5. Plug the right hand camshaft cover (3).
6. Remove the PCV tube (1) from the intake manifold assembly (2).



7. Disconnect the PCV tube (1) from the left hand camshaft cover (2).

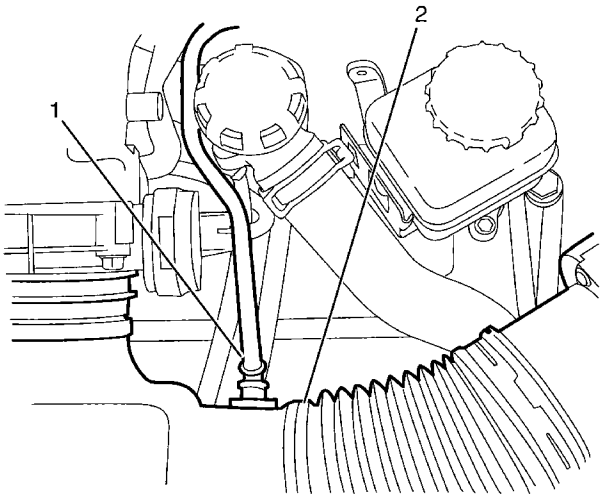
Important: Install a rubber cap or plug to the left hand camshaft cover (2) to prevent dust and dirt entry.

8. Plug the left hand camshaft cover (2).

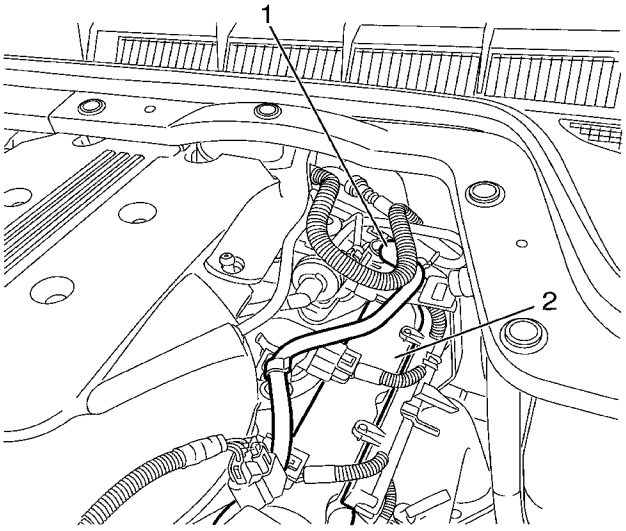


9. Disconnect the PCV tube (1) from the air intake assembly (2).

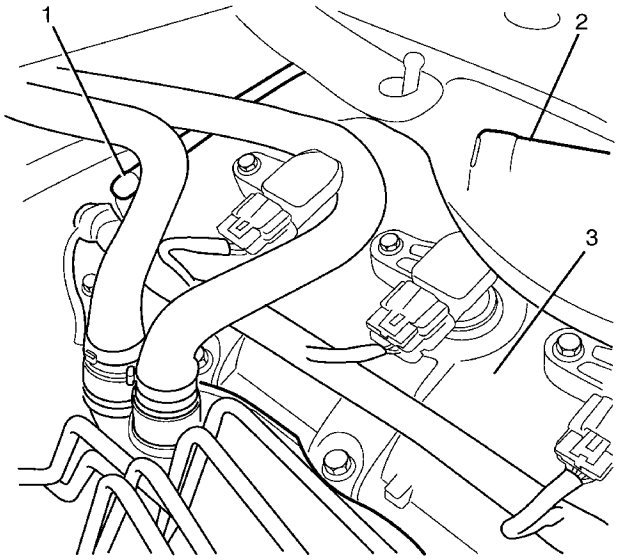
Installation Procedure



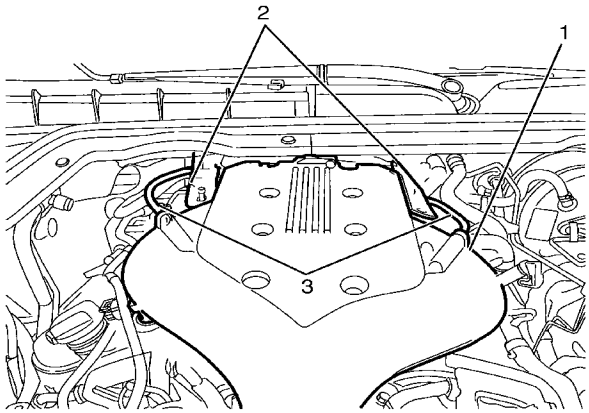
1. Connect the PCV tube (1) to the air intake assembly (2).



2. Remove the plug from the left hand camshaft cover (2).
3. Connect the PCV tube (1) to the left hand camshaft cover (2).



4. Install the PCV tube (1) to the intake manifold assembly (2).
5. Remove the plug from the right hand camshaft cover (3).
6. Connect the PCV tube (1) to the right camshaft cover (3).

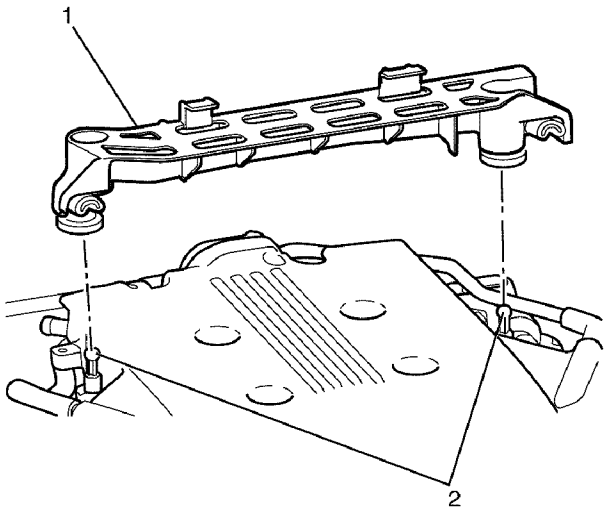


7. Connect the PCV tube (3) from both sides of the upper intake manifold assembly (2).
8. Attach the noise insulation panel (1) to the engine cover ball studs on the intake manifold assembly (2).
9. Install the engine covers. Refer to Engine Cover Replacement.

Intake Manifold Sight Shield Bracket Replacement

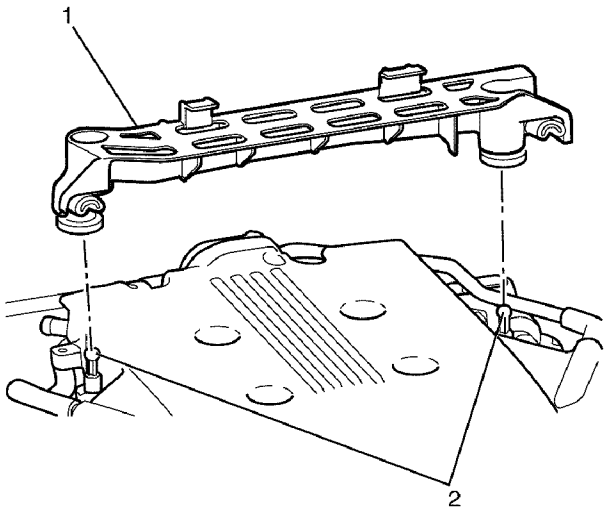
Removal Procedure

1. Remove the engine cover. Refer to Engine Cover Replacement.



2. Apply suitable upward pressure at both ends of the intake manifold sight shield bracket (1).
3. Remove the intake manifold sight shield bracket (1) from the intake manifold sight shield bracket supports (2).

Installation Procedure



© 2010 General Motors Corporation. All rights reserved.

1. Install the intake manifold sight shield bracket (1) to the intake manifold sight shield bracket supports (2).

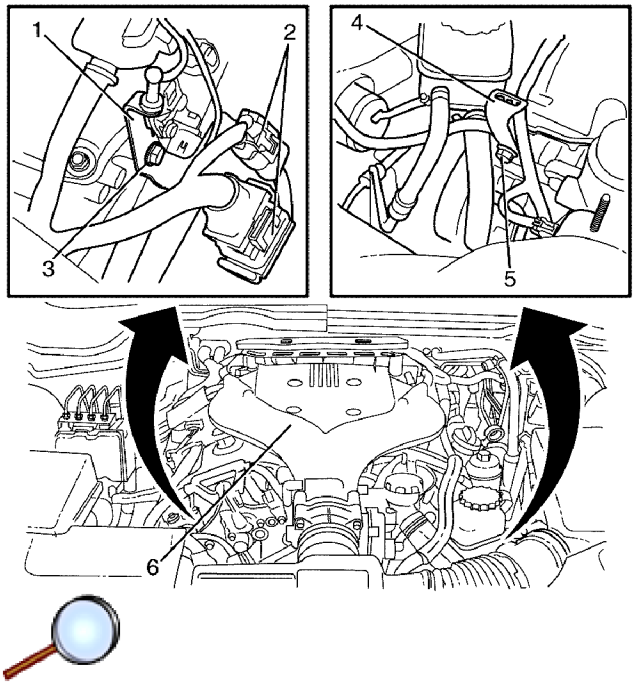
   Note: Apply equal pressure at both ends of the intake manifold sight shield bracket (1). Failure to comply may result in damage to the intake manifold sight shield bracket (1)

2. Apply equal suitable downward pressure at both ends of the intake manifold sight shield bracket (1) to engage the intake manifold sight shield bracket (1) to the intake manifold sight shield bracket supports (2).
3. Install the engine cover. Refer to Engine Cover Replacement.

Upper Intake Manifold Sight Shield Bracket Replacement

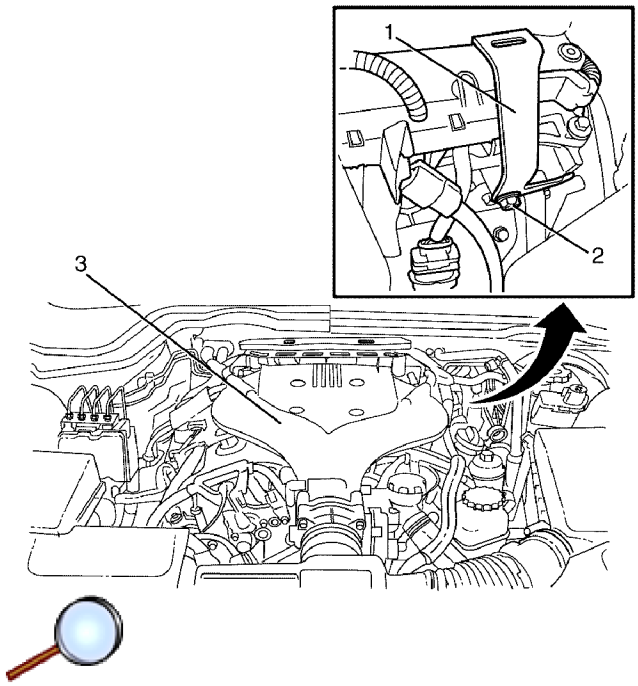
Removal Procedure

1. Remove the engine cover. Refer to Engine Cover Replacement.
2. Remove the intake manifold sight shield bracket. Refer to Intake Manifold Sight Shield Bracket Replacement.
3. Remove the intake air cleaner assembly. Refer to Air Cleaner Assembly Replacement.



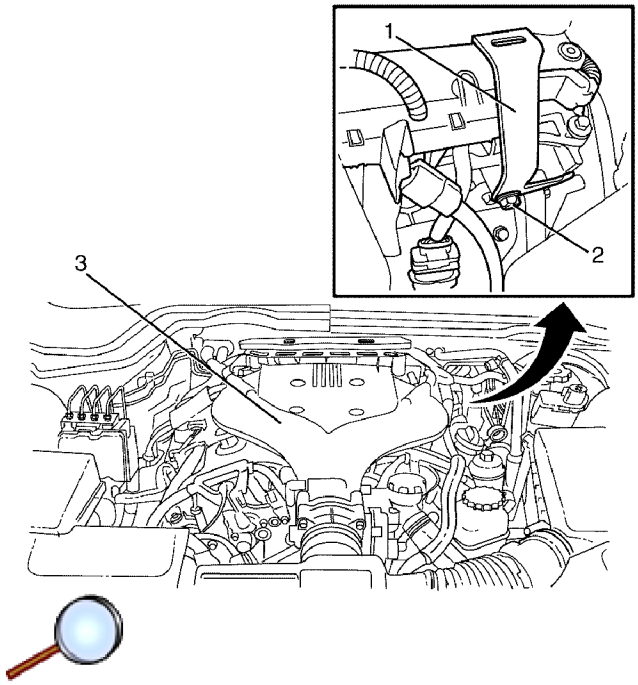
4. Detach the wiring harness connectors (2) from the upper intake manifold sight shield bracket (1).
5. Remove the upper intake manifold sight shield bracket to engine assembly bolt (3) from the upper intake manifold sight shield bracket (1).
6. Remove the upper intake manifold sight shield bracket (1) from the engine assembly (6).
7. Remove the upper intake manifold sight shield bracket to engine assembly bolt (5) from the upper intake manifold sight shield bracket (4).
8. Remove the upper intake manifold sight shield bracket (4) from the engine assembly (6).

© 2010 General Motors Corporation. All rights reserved.



9. Remove the upper intake manifold sight shield bracket to engine assembly bolt (2) from the upper intake manifold sight shield bracket (1).
10. Remove the upper intake manifold sight shield bracket (1) from the engine assembly (3).

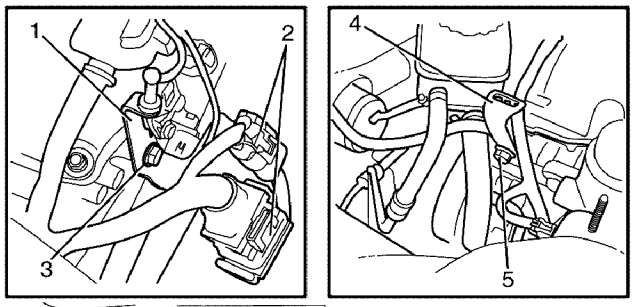
Installation Procedure

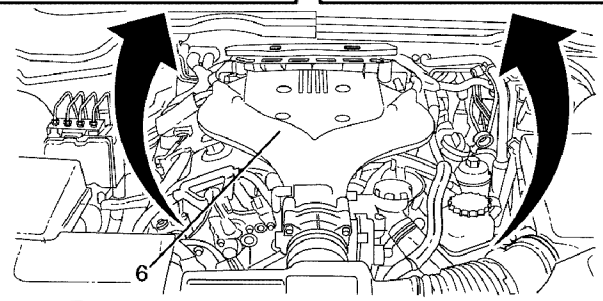


1. Install the upper intake manifold sight shield bracket (1) to the engine assembly (3).

   Caution: Refer to Fastener Caution in the Preface section.

2. Install the upper intake manifold sight shield bracket to engine assembly bolt (2) to the upper intake manifold sight shield bracket (1) and tighten to **35 N·m (26 lb in)**.





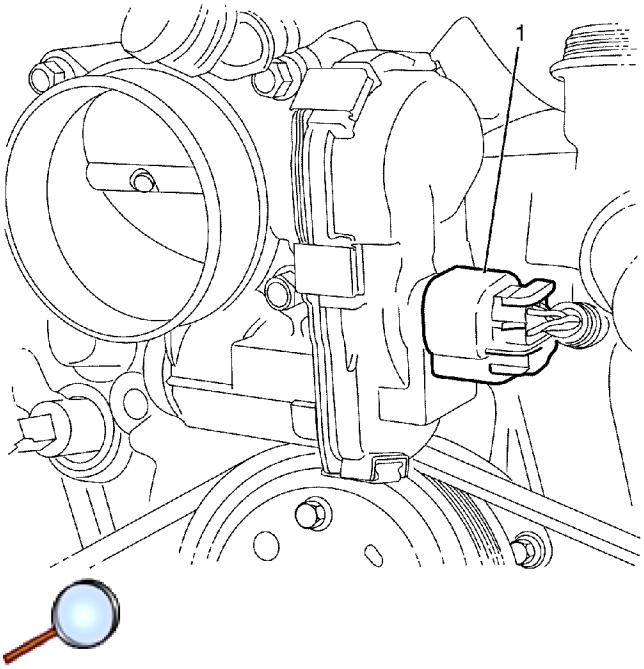
3. Install the upper intake manifold sight shield bracket (4) to the engine assembly (6).
4. Install the upper intake manifold sight shield bracket to engine assembly bolt (5) to the upper intake manifold sight shield bracket (4) and tighten to **35 N·m (26 lb in)**.
5. Install the upper intake manifold sight shield bracket (1) to the engine assembly (6).
6. Install the upper intake manifold sight shield bracket to engine assembly bolt (3) to the upper intake manifold sight shield bracket (1) and tighten to **35 N·m (26 lb in)**.
7. Attach the wiring harness connectors (2) to the upper intake manifold sight shield bracket (1).
8. Install the intake air cleaner assembly. Refer to Air Cleaner Assembly Replacement.
9. Install the intake manifold sight shield bracket. Refer to Intake Manifold Sight Shield Bracket Replacement.
10. Install the engine cover. Refer to Engine Cover Replacement.

Upper Intake Manifold Replacement

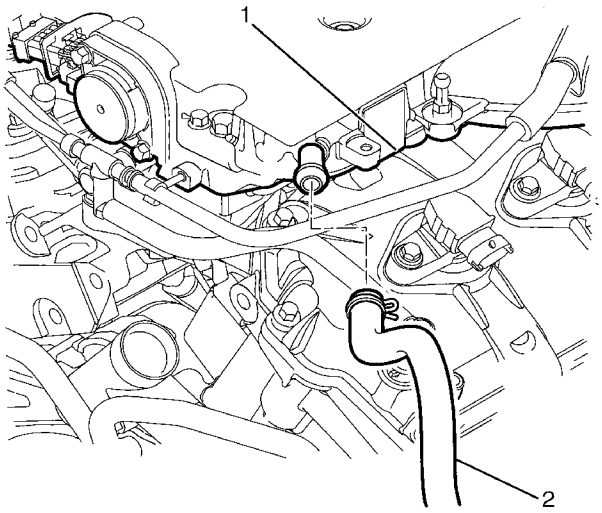
Removal Procedure

Warning: Refer to Battery Disconnect Warning in the Preface section.

1. Disconnect the battery ground cable. Refer to Battery Negative Cable Disconnection and Connection.
2. Remove the engine covers. Refer to Engine Cover Replacement.
3. Remove the air intake duct. Refer to Air Cleaner Inlet Duct Replacement.

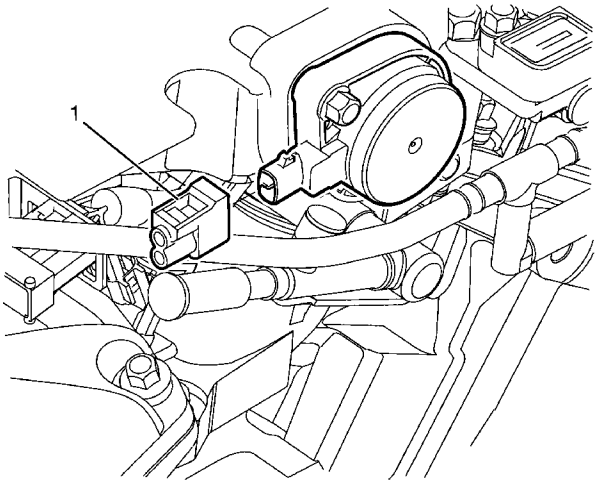


4. Disconnect the throttle body electrical connector (1).

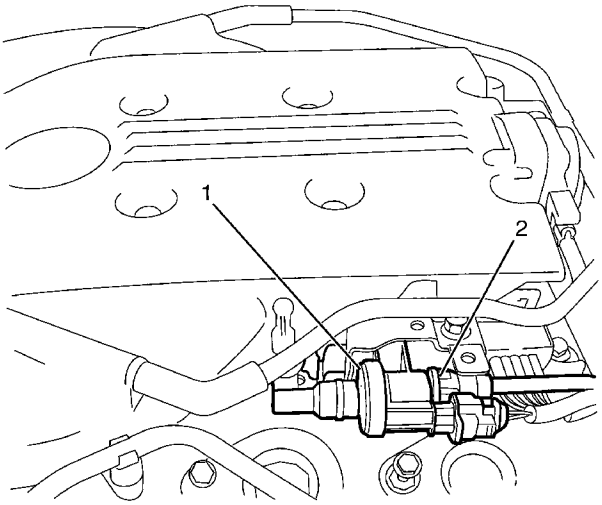


© 2010 General Motors Corporation. All rights reserved.

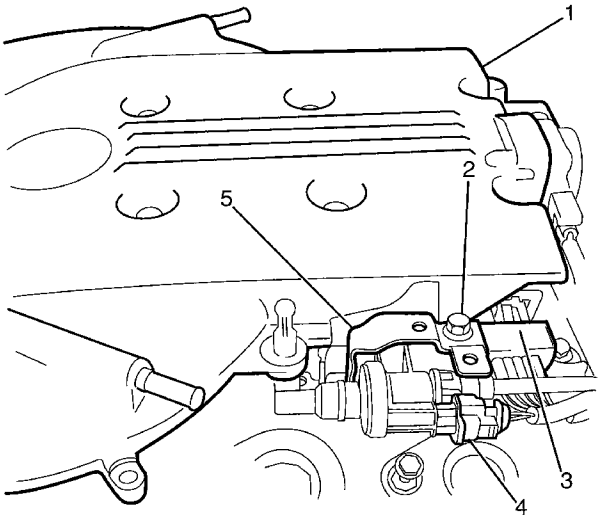
5. Disconnect the brake booster vacuum hose (2) from the intake manifold (1).



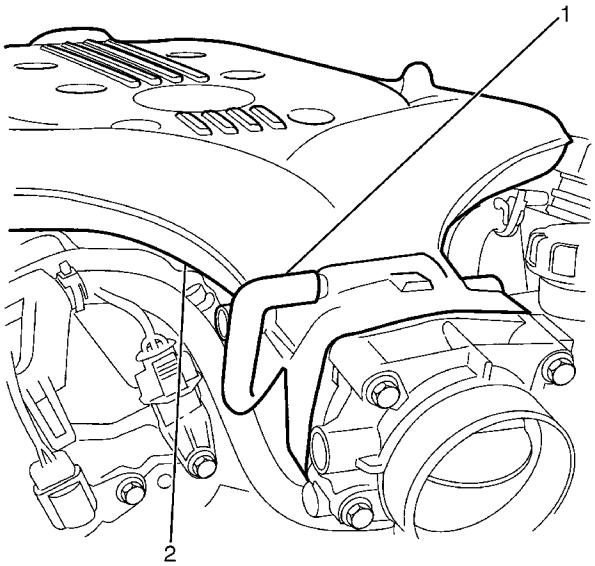
6. Disconnect the Inlet Manifold Runner Control (IMRC) electrical connector (1).



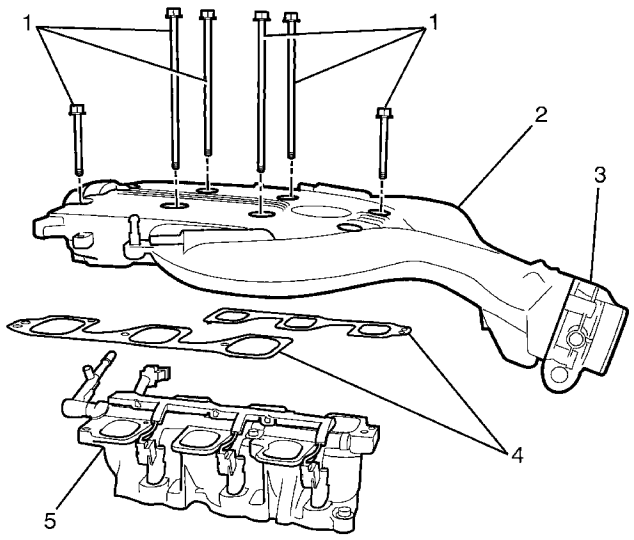
7. Disconnect the evaporative emission (EVAP) purge line (1) from the purge solenoid (2). Refer to Metal Collar Quick Connect Fitting Service or Plastic Collar Quick Connect Fitting Service.
8. Plug or cap the (EVAP) purge line (1) and the purge solenoid (2) ends.



9. Disconnect the EVAP valve electrical connector (4)
10. Disconnect the fuel injector harness electrical connector (3)
11. Remove the fuel injector harness electrical connector/EVAP valve mounting bracket to intake manifold retaining bolt (2).
12. Reposition the fuel injector harness electrical connector/EVAP valve mounting bracket (5) away from the intake manifold (1).
13. Remove the PCV tube and PCV fresh air tubes. Refer to Positive Crankcase Ventilation Hose/Pipe/Tube Replacement.



14. Disconnect the EVAP hose (1) from the intake manifold (2).



15. Remove the upper intake manifold bolts (1).
16. Remove the upper intake manifold (2) and the throttle body (3) as an assembly.

    Note: The upper intake manifold gaskets (4) must be discarded after removal.

17. Remove the upper intake manifold gaskets (4).

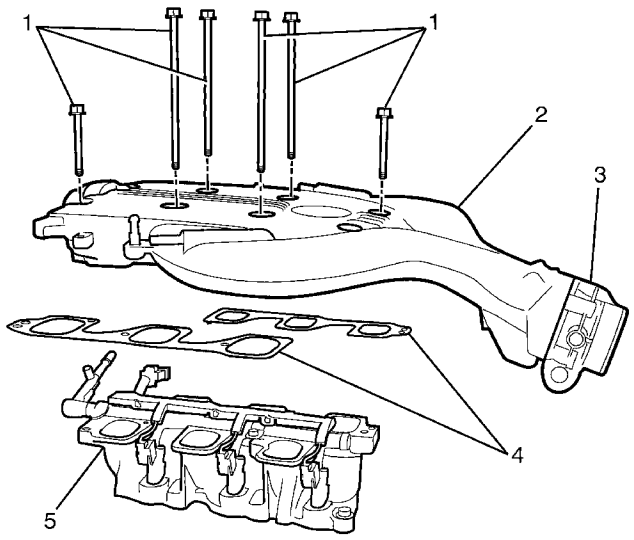
    Discard the gaskets

    Note: The lower intake manifold (5) must be plugged with a clean lint free cloth to prevent foreign matter entry into the engine.

18. Plug the lower intake manifold (5) with a clean lint free cloth.
19. If the upper intake manifold is being replaced, disassemble the intake manifold. Refer to Intake Manifold Disassemble.
20. Clean and inspect the intake manifold. Refer to Intake Manifold Cleaning and Inspection.

Installation Procedure

1. If the upper intake manifold is being replaced, assemble the intake manifold. Refer to Intake Manifold Assemble.

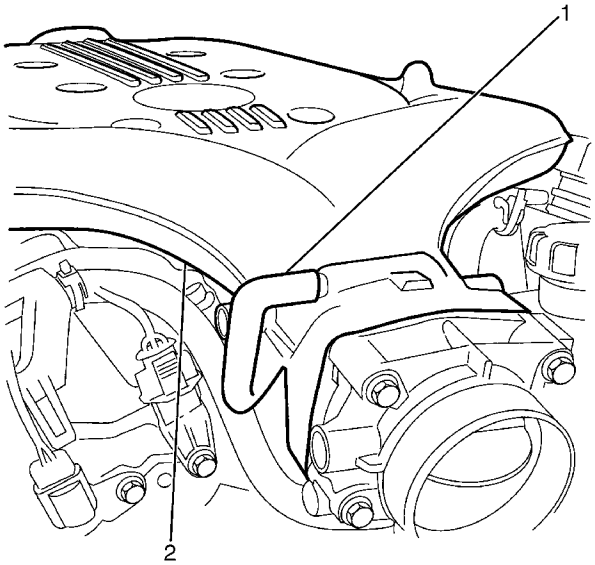


2. Remove the clean lint free cloth from the lower intake manifold (5)
3. Install NEW upper intake manifold gaskets (4).
4. Install the upper intake manifold (2) and the throttle body (3) as an assembly.

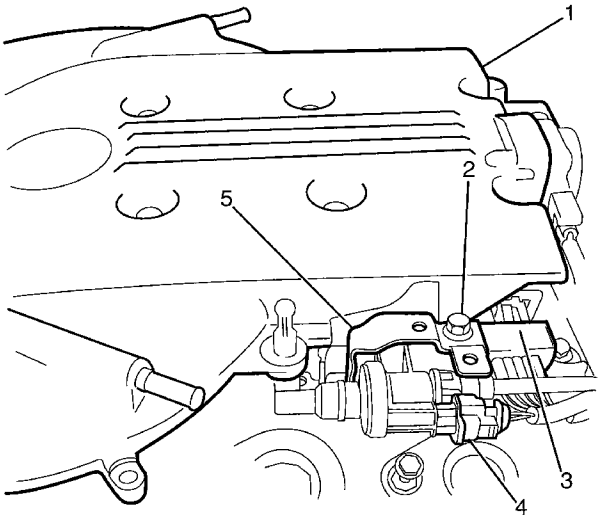
Caution: Refer to Fastener Caution in the Preface section.

Note: Tighten the intake manifold bolts (1) in a circular pattern starting at the center (long bolts) and moving outward.

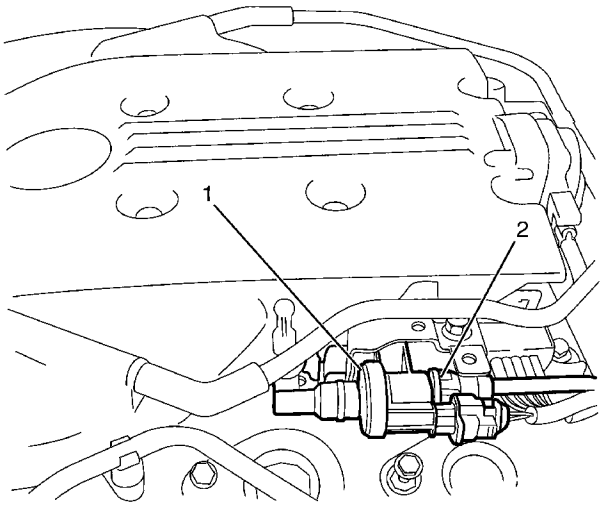
5. Install the upper intake manifold bolts (1) and tighten to **23 N·m (17 lb ft)**.



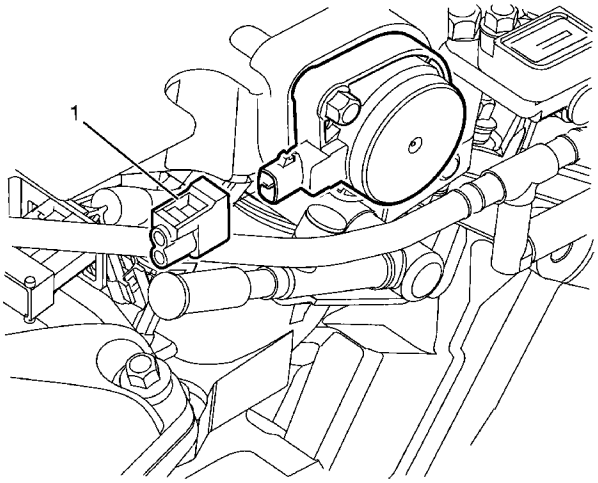
6. Connect the EVAP line (1) to the intake manifold (2).



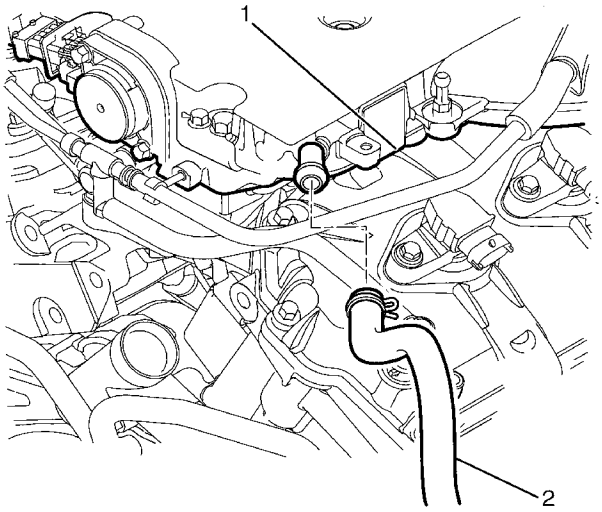
7. Install the fuel injector harness electrical connector/EVAP valve mounting bracket (5) to the intake manifold (1).
8. Install the fuel injector harness electrical connector/EVAP valve mounting bracket to intake manifold retaining bolt (2).
9. Connect the fuel injector harness electrical connector (3)
10. Connect the EVAP valve electrical connector (4)
11. Install the PCV tube and PCV fresh air tubes. Refer to Positive Crankcase Ventilation Hose/Pipe/Tube Replacement.



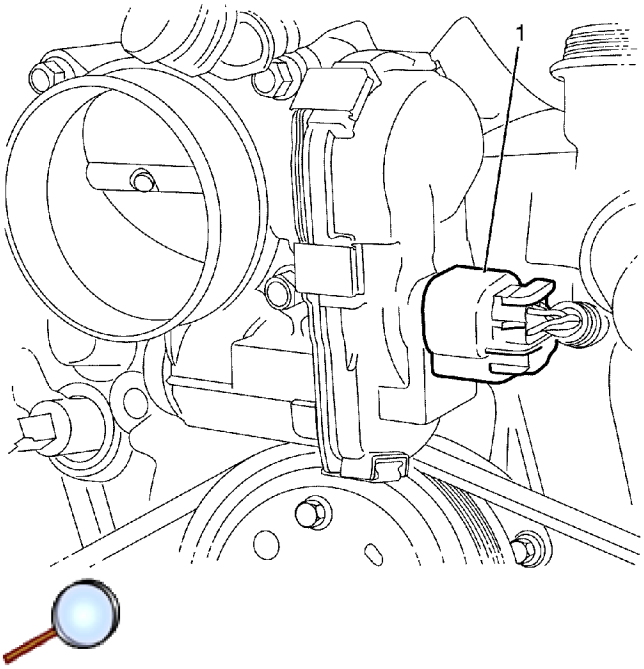
12. Remove the plug or cap from the (EVAP) purge line (1) and the purge solenoid (2) ends.
13. Connect the evaporative emission (EVAP) purge line (1) from the purge solenoid (2). Refer to Metal Collar Quick Connect Fitting Service or Plastic Collar Quick Connect Fitting Service.



14. Connect the Inlet Manifold Runner Control (IMRC) electrical connector (1).



15. Connect the brake booster vacuum hose (2) to the intake manifold (1).

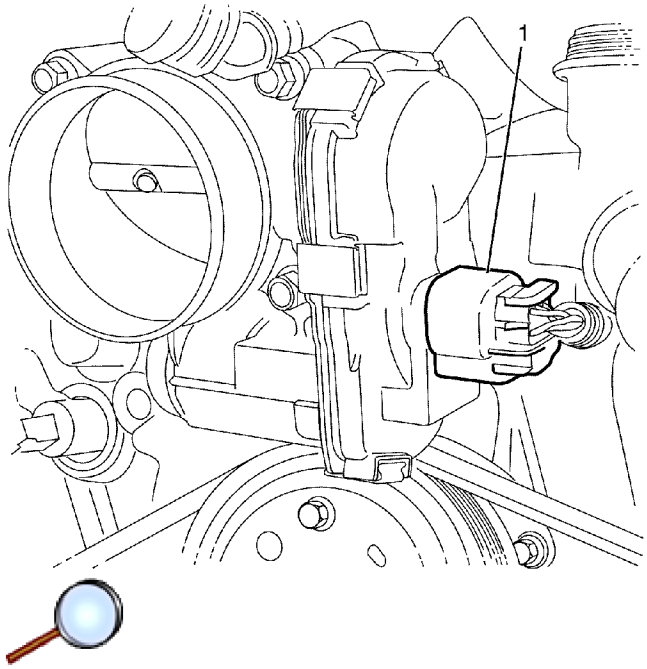


16. Connect the throttle body electrical connector (1).
17. Install the air intake duct. Refer to Air Cleaner Inlet Duct Replacement.
18. Install the engine covers. Refer to Engine Cover Replacement.
19. Connect the battery ground cable. Refer to Battery Negative Cable Disconnection and Connection.

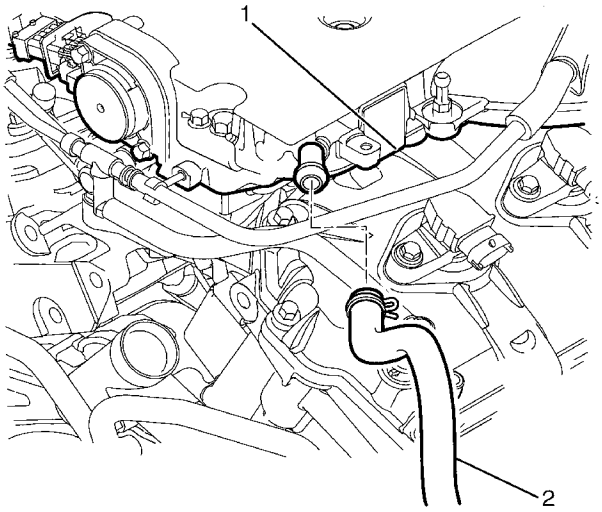
Lower Intake Manifold Replacement

Warning: Refer to Battery Disconnect Warning in the Preface section.

1. Disconnect the battery ground cable. Refer to Battery Negative Cable Disconnection and Connection.
2. Remove the engine covers. Refer to Engine Cover Replacement.
3. Remove the air intake duct. Refer to Air Cleaner Inlet Duct Replacement.

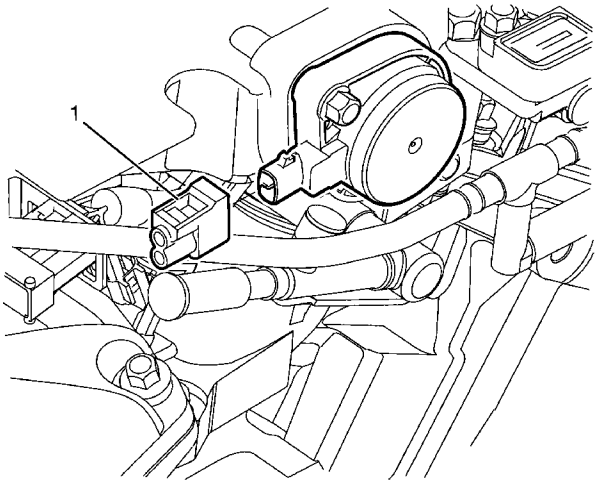


4. Disconnect the throttle body electrical connector (1).

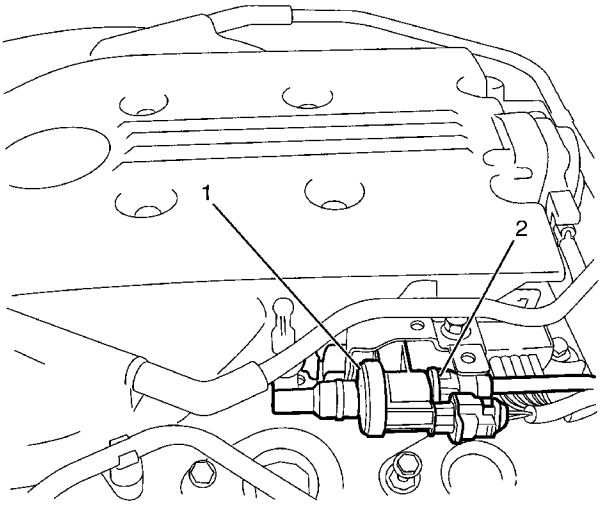


© 2010 General Motors Corporation. All rights reserved.

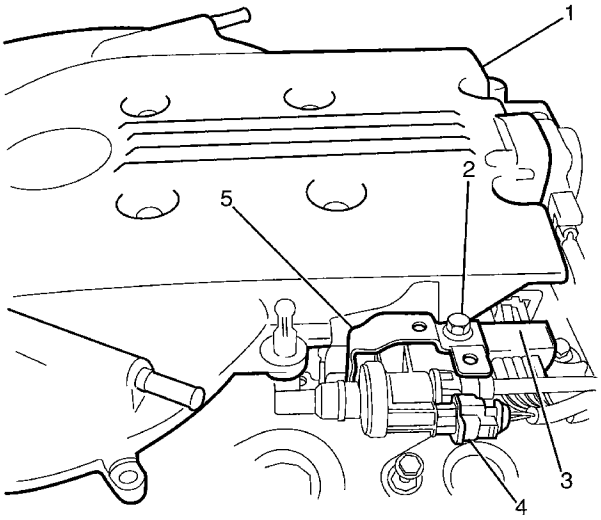
5. Disconnect the brake booster vacuum hose (2) from the intake manifold (1).



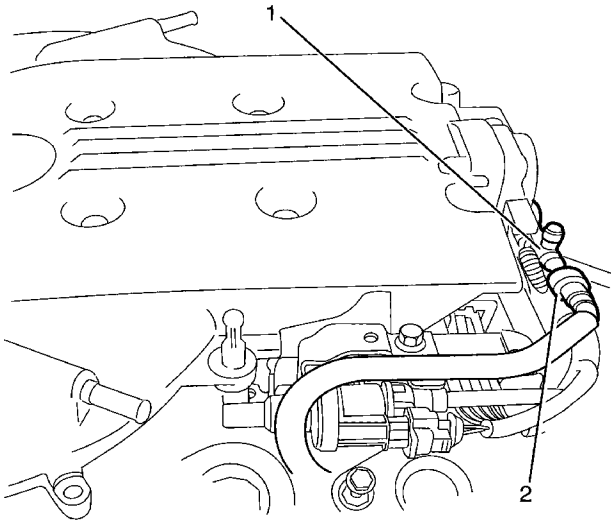
6. Disconnect the Inlet Manifold Runner Control (IMRC) solenoid connector (1).



7. Disconnect the evaporative emission (EVAP) purge line (1) from the purge solenoid (2). Refer to Metal Collar Quick Connect Fitting Service or Plastic Collar Quick Connect Fitting Service.
8. Plug or cap the (EVAP) purge line (1) and the purge solenoid (2) ends.
9. Remove the PCV tube and PCV fresh air tubes. Refer to Positive Crankcase Ventilation Hose/Pipe/Tube Replacement.



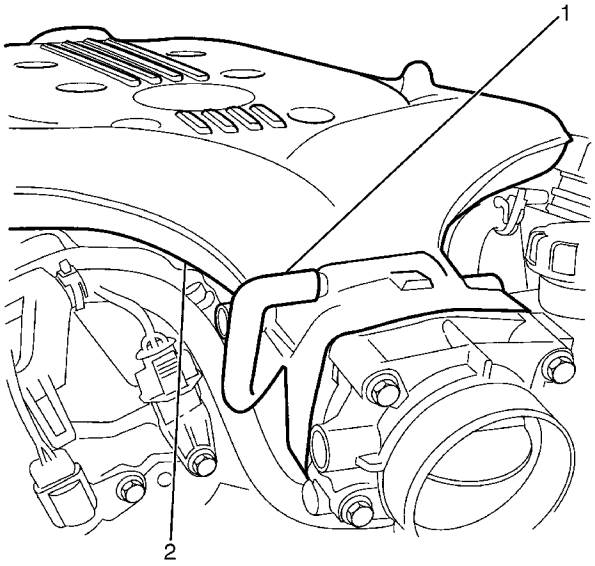
10. Disconnect the EVAP valve electrical connector (4)
11. Disconnect the fuel injector harness electrical connector (3)
12. Remove the fuel injector harness electrical connector/EVAP valve mounting bracket to intake manifold retaining bolt (2).
13. Reposition the fuel injector harness electrical connector/EVAP valve mounting bracket (5) away from the intake manifold (1).



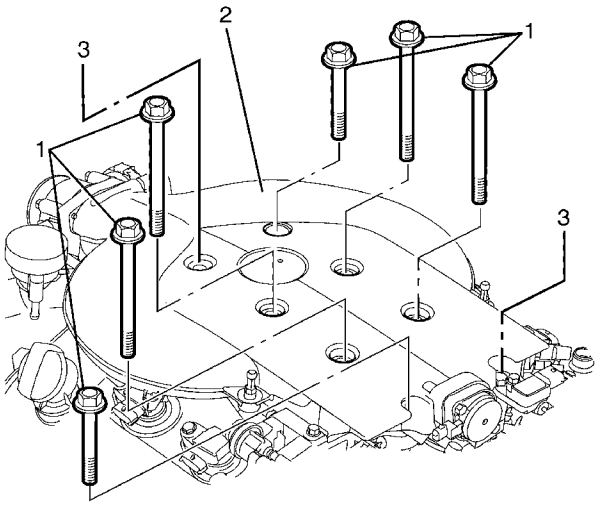
14. Disconnect the fuel feed pipe (2) from the fuel rail (1). Refer to Metal Collar Quick Connect Fitting Service or Plastic Collar Quick Connect Fitting Service.

Note: Plug or cap the fuel feed pipe (2) and fuel rail (1) ends to prevent fuel leaks and/or contamination.

15. Plug or cap the fuel feed pipe (2) and fuel rail (1) ends.



16. Disconnect the EVAP line (1) from the intake manifold (2).



Note:

- DO NOT remove the upper intake manifold to lower intake manifold retaining bolts (3).
- DO NOT kink or damage the fuel pipe.

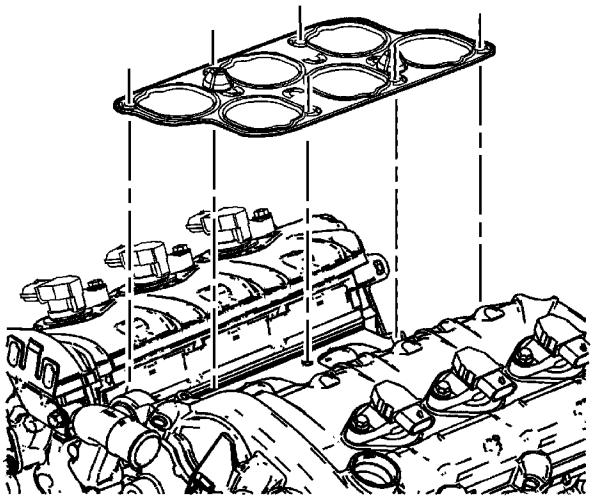
17. Remove the intake manifold to cylinder head retaining bolts (1).
18. Remove the intake manifold assembly (2).

Note: The cylinder heads and engine valley must be plugged with a clean lint free cloth to prevent foreign matter entry into the engine.

19. Plug the cylinder heads and engine valley with a clean lint free cloth.
20. Disassemble the intake manifold as to replace the lower intake manifold. Refer to Intake Manifold Disassemble.
21. Clean and inspect the intake manifold and the sealing surfaces. Refer to Intake Manifold Cleaning and Inspection.

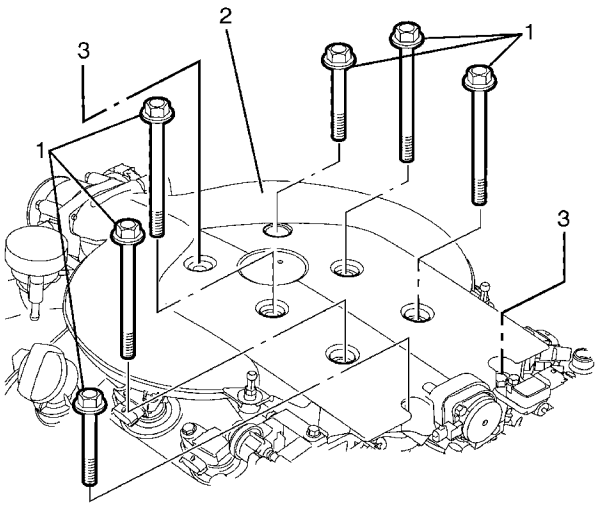
Installation Procedure

1. Assemble the intake manifold as necessary. Refer to Intake Manifold Assemble.
2. Remove the clean lint free cloth from the cylinder heads and engine valley.



Note: Inspect and replace the lower intake manifold gasket only if the gasket is worn or damaged.

3. Install the lower intake manifold gasket.

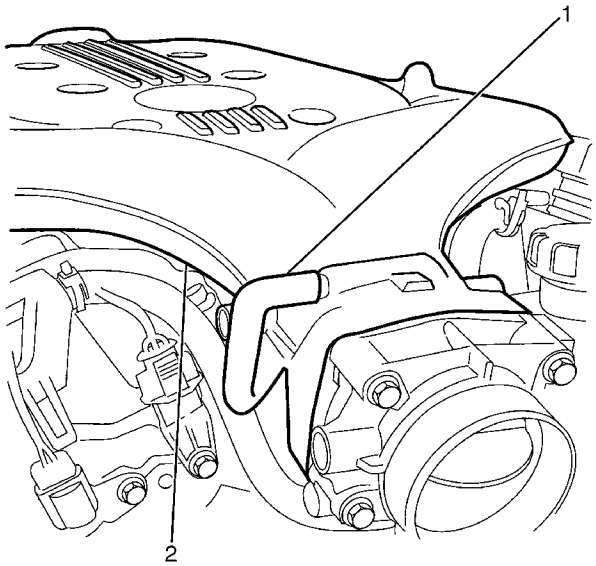


4. Install the intake manifold assembly (2).

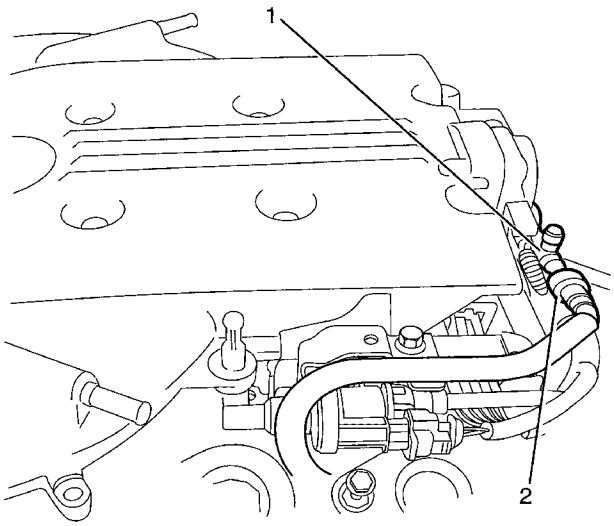
Caution: Refer to Fastener Caution in the Preface section.

Note: Tighten the intake manifold to cylinder head retaining bolts (1) in a circular pattern starting at the center (long bolts) and moving outward.

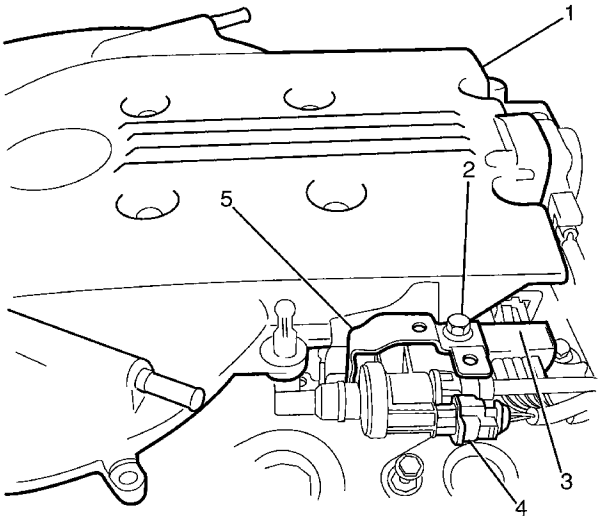
5. Install the intake manifold using the cylinder head retaining bolts (1) and tighten to **23 N·m (17 lb ft)**.



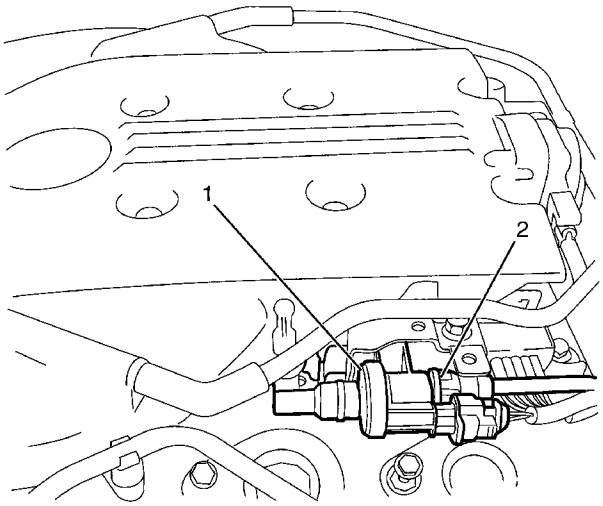
6. Connect the EVAP line (1) to the intake manifold (2).



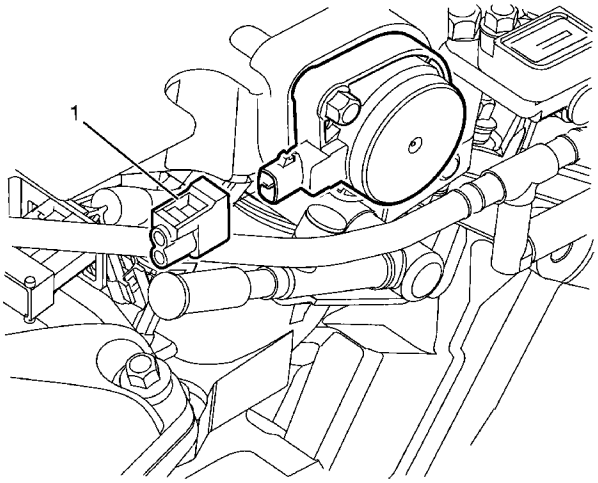
7. Remove the plug or cap at the fuel feed pipe (1) and fuel rail (2) ends
8. Connect the fuel feed pipe (1) to the fuel rail (2). Refer to Metal Collar Quick Connect Fitting Service or Plastic Collar Quick Connect Fitting Service.



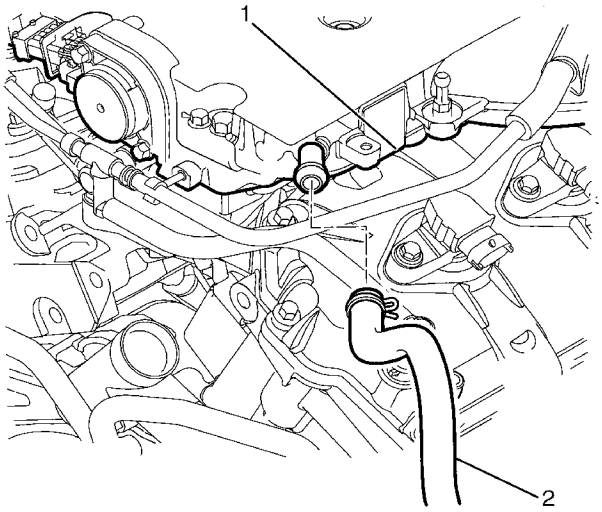
9. Install the fuel injector harness electrical connector/EVAP valve mounting bracket (5) to the intake manifold (1).
10. Install the fuel injector harness electrical connector/EVAP valve mounting bracket to intake manifold retaining bolt (2).
11. Connect the fuel injector harness electrical connector (3)
12. Connect the EVAP valve electrical connector (4)
13. Install the PCV tube and PCV fresh air tubes. Refer to Positive Crankcase Ventilation Hose/Pipe/Tube Replacement.



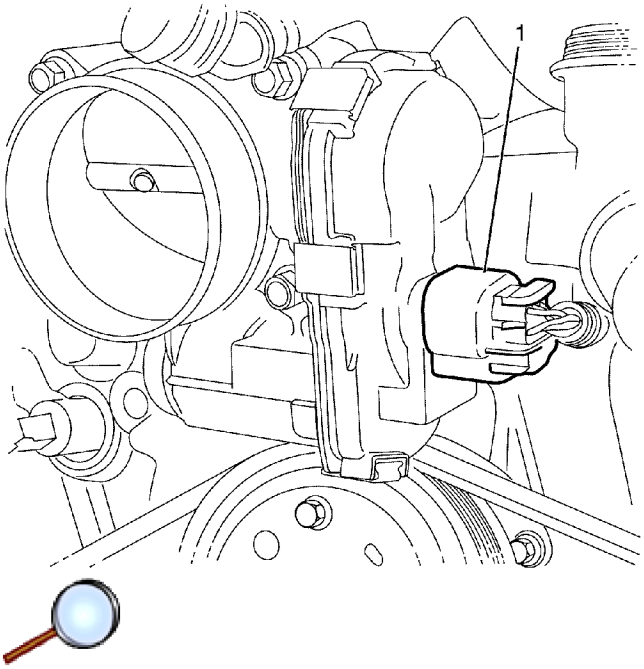
14. Remove the plug or cap from the (EVAP) purge line (2) and the purge solenoid (1) ends.
15. Connect the evaporative emission (EVAP) purge line (2) from the purge solenoid (1). Refer to Metal Collar Quick Connect Fitting Service or Plastic Collar Quick Connect Fitting Service.



16. Connect the Inlet Manifold Runner Control (IMRC) electrical connector (1).



17. Connect the brake booster vacuum hose (2) to the intake manifold (1).

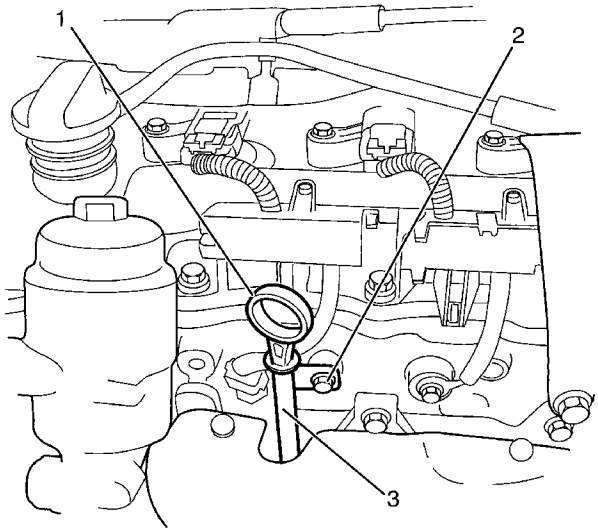


18. Connect the throttle body electrical connector (1).
19. Install the air intake duct. Refer to Air Cleaner Inlet Duct Replacement.
20. Install the engine covers. Refer to Engine Cover Replacement.
21. Connect the battery ground cable. Refer to Battery Negative Cable Disconnection and Connection.

Oil Level Indicator Tube Replacement

Removal Procedure

1. Turn the ignition OFF.



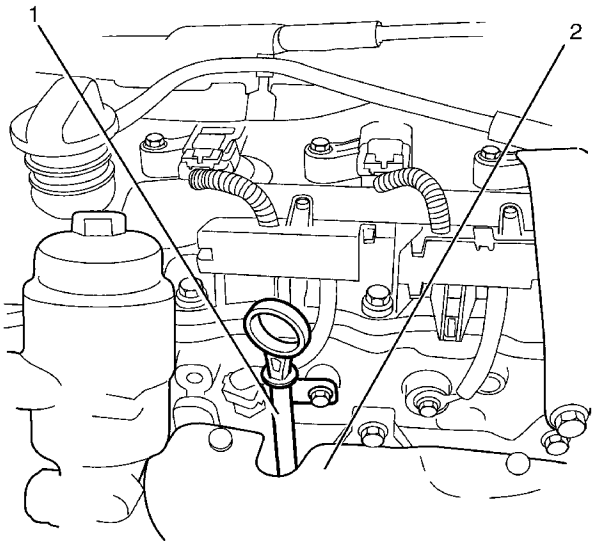
2. Remove the oil level indicator tube bracket to cylinder head retaining bolt (2).
3. Remove the oil level indicator (1) from the oil level indicator tube (3).

Warning: Refer to Safety Glasses Warning in the Preface section.

Danger: To avoid any vehicle damage, serious personal injury or death when major components are removed from the vehicle and the vehicle is supported by a hoist, support the vehicle with jack stands at the opposite end from which the components are being removed and strap the vehicle to the hoist.

4. Raise and support the vehicle. Refer to Lifting and Jacking the Vehicle.
5. Remove the knock sensor. Refer to Knock Sensor Replacement - Bank 2.
6. Lower the vehicle.

© 2010 General Motors Corporation. All rights reserved.



7. Remove the oil level indicator tube (1) up through the exhaust manifold (2).
8. If you are replacing only the oil level indicator tube seal, remove and discard the old seal.

Installation Procedure

1. Install the oil level indicator and tube. Refer to Oil Level Indicator and Tube Installation.

   Warning: Refer to Safety Glasses Warning in the Preface section.

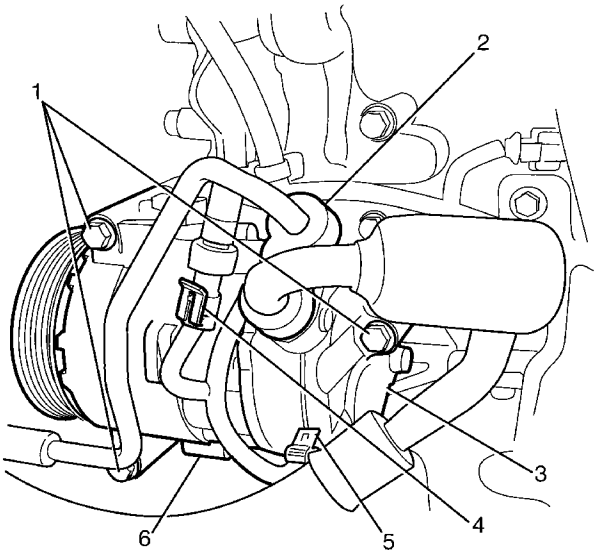
   Danger: To avoid any vehicle damage, serious personal injury or death when major components are removed from the vehicle and the vehicle is supported by a hoist, support the vehicle with jack stands at the opposite end from which the components are being removed and strap the vehicle to the hoist.

2. Raise and support the vehicle. Refer to Lifting and Jacking the Vehicle.
3. Install the knock sensor. Refer to Knock Sensor Replacement - Bank 2.
4. Lower the vehicle.

Oil Filter Adapter Replacement

Removal Procedure

1. Remove the engine covers. Refer to Engine Cover Replacement .
2. Remove the oil filter. Refer to Engine Oil and Oil Filter Replacement .
3. Remove the drive belt. Refer to Drive Belt Replacement - Accessory .



4. Disconnect the A/C pressure transducer electrical connector (4).
5. Disconnect the A/C compressor electrical connector (5).

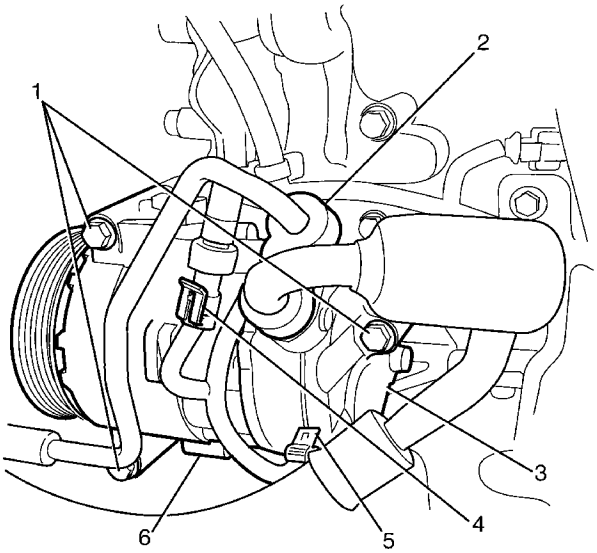
Important: DO NOT disconnect the A/C pipes (2) from the A/C compressor (6).

6. Remove the A/C compressor to A/C compressor/power steering pump mounting bracket retaining bolts (1).
7. Secure and reposition the A/C compressor (6) away from the A/C compressor mounting bracket (3) in order to gain access to the oil filter adapter to cylinder block retaining bolts.
8. Remove the oil filter adapter. Refer to Oil Filter Adapter Removal .

Installation Procedure

1. Install the oil filter adapter. Refer to Oil Filter Adapter Installation .

© 2010 General Motors Corporation. All rights reserved.



Important: Make sure the A/C pipes (2) are not twisted or kinked upon compressor installation.

2. Install the A/C compressor (6) with the A/C pipes (2) to the A/C compressor mounting bracket (3).
3. Install the A/C compressor to A/C compressor mounting bracket retaining bolts (1).
4. Connect the A/C pressure transducer electrical connector (4).
5. Connect the A/C compressor electrical connector (5).
6. Install the drive belt. Refer to Drive Belt Replacement .
7. Install the oil filter. Refer to Engine Oil and Oil Filter Replacement .

Crankshaft Balancer Replacement

Special Tools

- EN 46106 Flywheel Holding Tool.
- J 45059 Angle Meter.

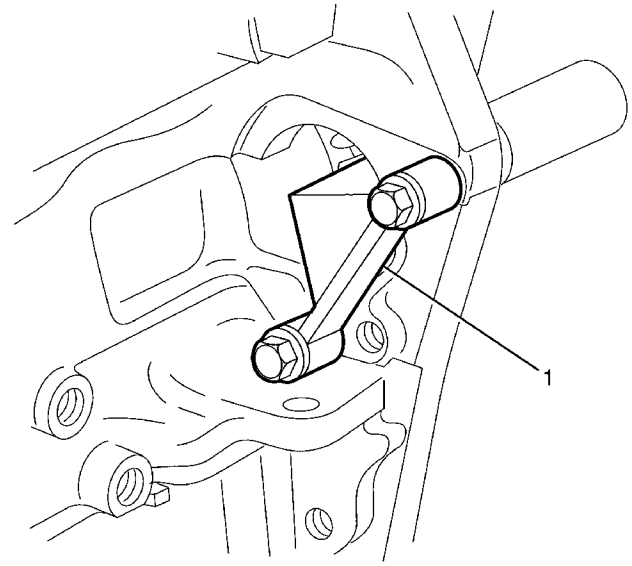
Removal Procedure

1. Remove the drive belt. Refer to Drive Belt Replacement.

   Warning: Refer to Safety Glasses Warning in the Preface section.

   Danger: To avoid any vehicle damage, serious personal injury or death when major components are removed from the vehicle and the vehicle is supported by a hoist, support the vehicle with jack stands at the opposite end from which the components are being removed and strap the vehicle to the hoist.

2. Raise and support the vehicle. Refer to Lifting and Jacking the Vehicle.
3. Remove the starter motor. Refer to Starter Motor Replacement.



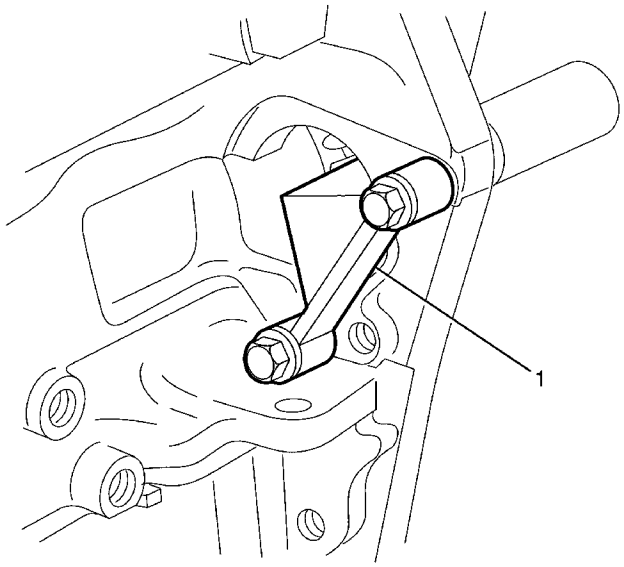
4. Install the EN 46106 (1) through the starter mounting hole.
5. Lower the vehicle.
6. Remove the front air deflector. Refer to Front Air Deflector Replacement.
7. Remove the crankshaft balancer. Refer to Crankshaft Balancer Removal.

Installation Procedure

1. Install the crankshaft balancer. Refer to Crankshaft Balancer Installation.

© 2010 General Motors Corporation. All rights reserved.

2. Install the front air deflector. Refer to Front Air Deflector Replacement.
3. Raise the vehicle.



4. Remove EN 46106 (1) from the starter mounting hole.
5. Remove the starter motor. Refer to Starter Motor Replacement.
6. Install the drive belt. Refer to Drive Belt Replacement.

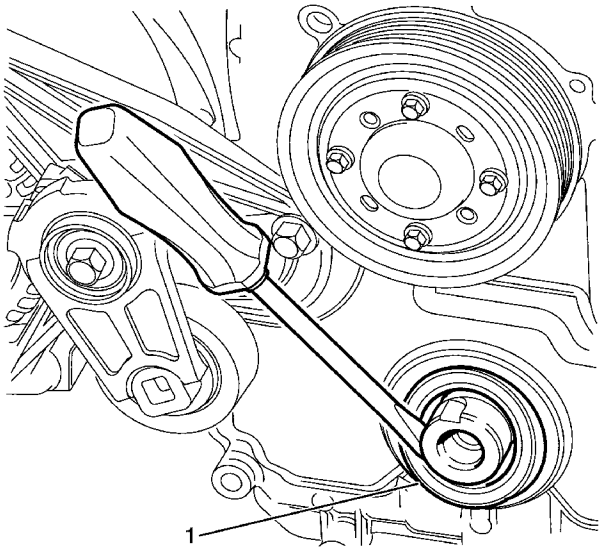
Crankshaft Front Oil Seal Replacement

Tools Required

J 29184 Oil Seal Installer

Removal Procedure

1. Remove the drive belt. Refer to Drive Belt Replacement.
2. Remove the crankshaft balancer. Refer to Crankshaft Balancer Replacement.

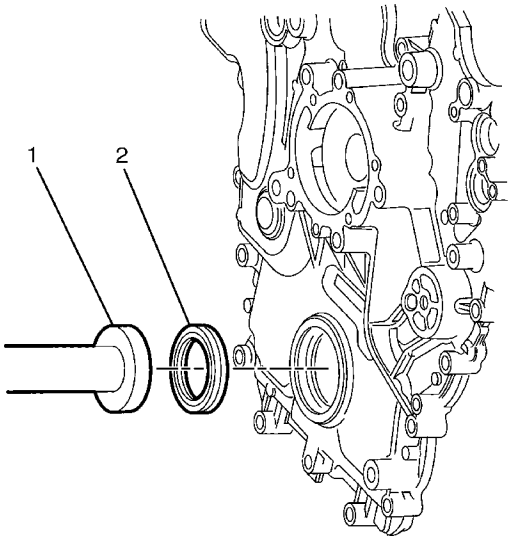


Important: DO NOT damage the sealing surfaces of the front cover or the crankshaft when prying the crankshaft front oil seal for removal. Damaging the sealing surface may cause leakage or require replacement of the damaged component.

3. Use a flat-bladed tool in order to remove the crankshaft oil seal (1).

Installation Procedure

© 2010 General Motors Corporation. All rights reserved.



Important: DO NOT lubricate the crankshaft front oil seal or the crankshaft balancer sealing surfaces.

1. Use the J 29184 (1) or equivalent to install the crankshaft front oil seal (2).
2. Install the crankshaft balancer. Refer to Crankshaft Balancer Installation.
3. Install the drive belt. Refer to Drive Belt Replacement.

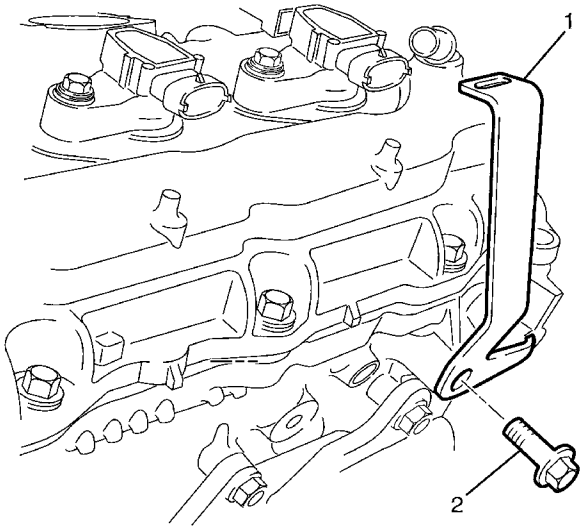
Camshaft Cover Replacement - Left Side

Special Tools

EN 46101 Spark Plug Tube Plugs

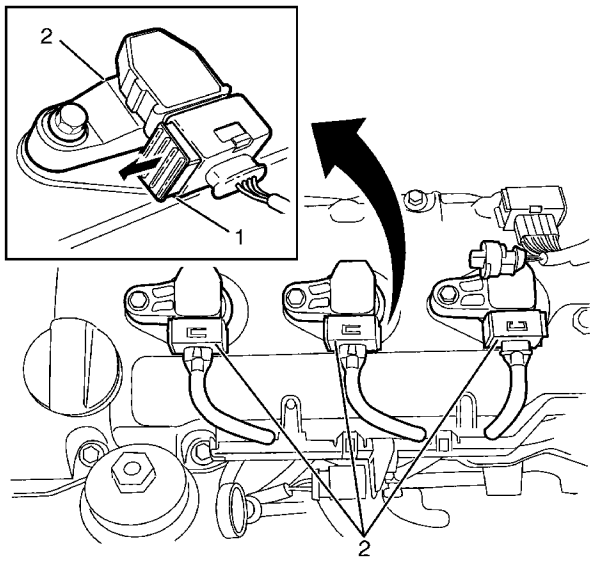
Removal Procedure

1. Remove the engine covers. Refer to Engine Cover Replacement.
2. Remove the upper intake manifold with the lower intake manifold. Refer to Lower Intake Manifold Replacement.



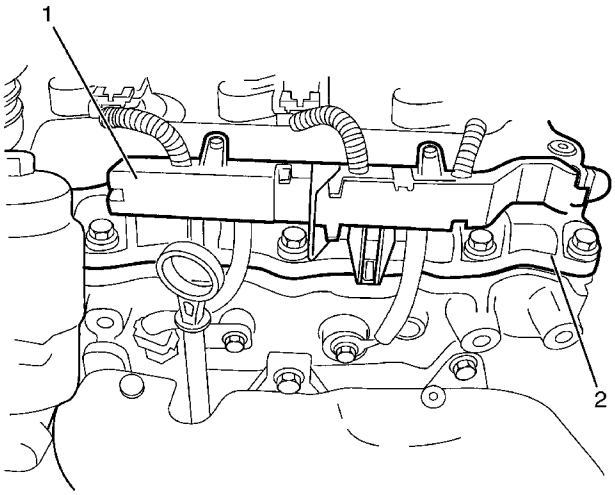
3. Remove the engine covers mounting bracket to cylinder head retaining bolt (2).
4. Remove the engine covers mounting bracket (1).

© 2010 General Motors Corporation. All rights reserved.



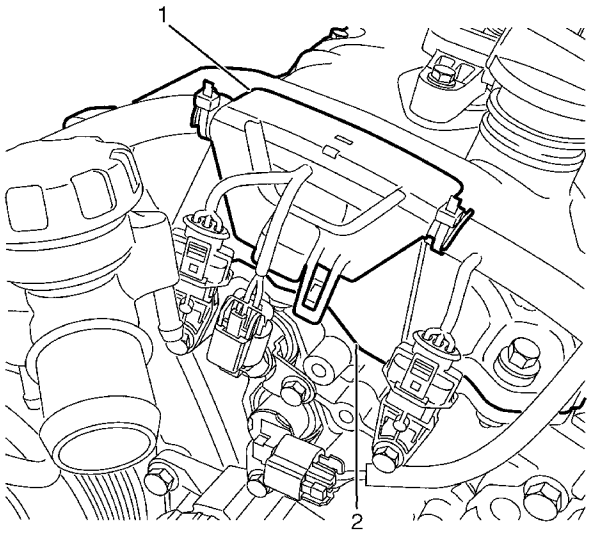
Note: Use a suitable tool to slide the connector retaining latch (1) in the direction of the arrow.

5. Disconnect the ignition coil electrical connectors (2).



Note: Use a suitable tool to detach the wiring harness (1) clips from the camshaft cover (2), then lift the wiring harness (1) upwards to detach from the camshaft cover (2).

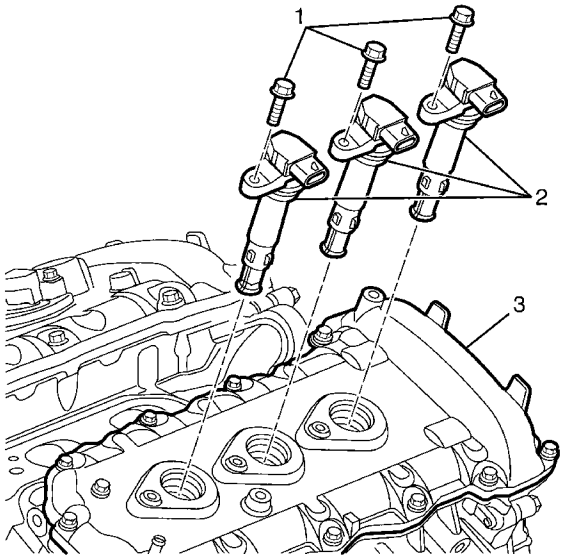
6. Remove the wiring harness (1) from the camshaft cover (2).



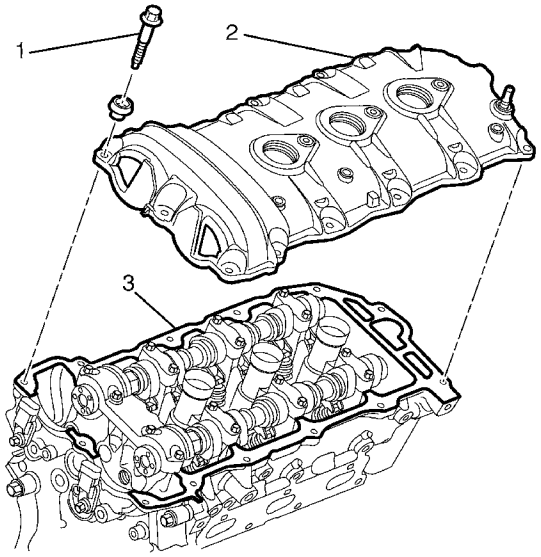
Note: It is not necessary to disconnect the engine front cover electrical connectors.

Note: Use a suitable tool to detach the wiring harness (1) clip from the camshaft cover (2), then lift the wiring harness (1) upwards to detach from the camshaft cover (2).

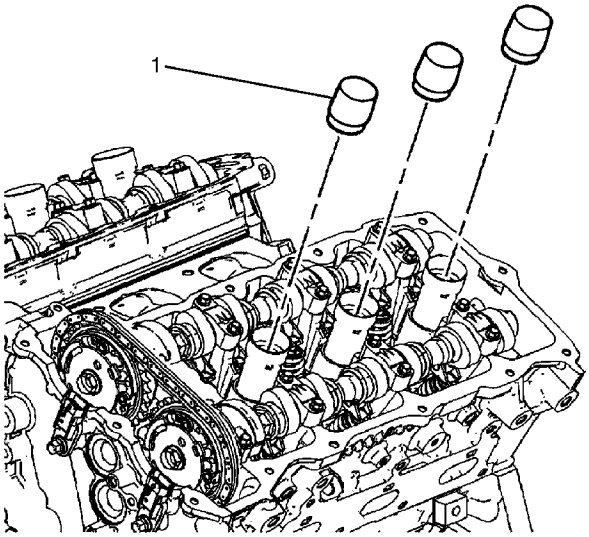
7. Remove the wiring harness (1) from the front of the camshaft cover (2).
8. Reposition and secure the wiring harness (1) away from the camshaft cover (2) in order to provide clearance for removal of the camshaft cover (2).



9. Remove the ignition coil to camshaft cover retaining bolts (1).
10. Remove the ignition coils (2) from the camshaft cover (3).



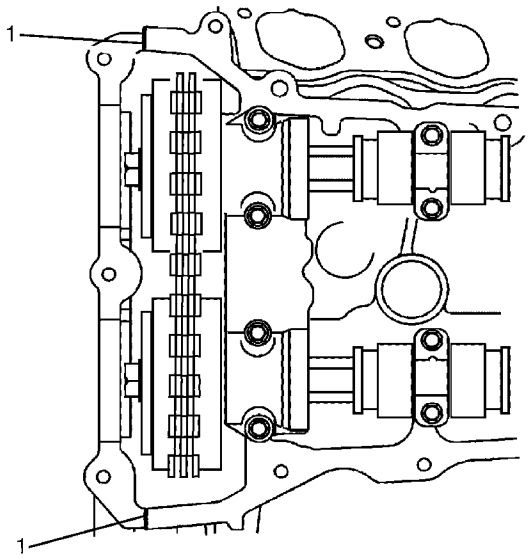
11. Remove the camshaft cover to cylinder head retaining bolts (1).
12. Remove the camshaft cover (2) from the cylinder head (3).
13. Remove and discard the camshaft cover seal and grommets.



14. Install the EN-46101 (1) to the spark plug tubes to prevent dirt and other contaminants from entering the cylinders.

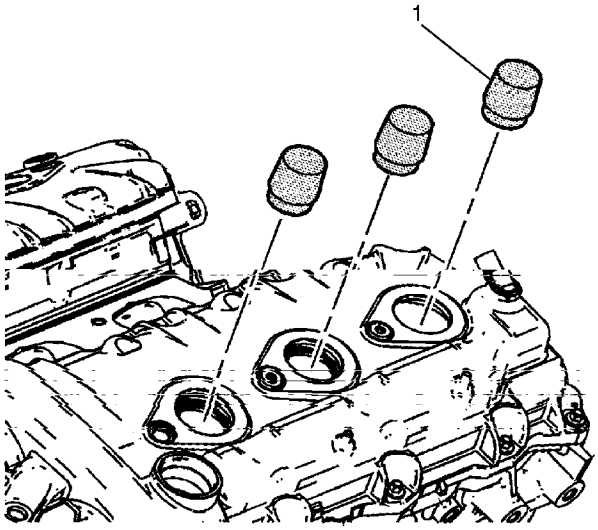
Installation Procedure

1. Install a NEW camshaft cover seal and NEW grommets.



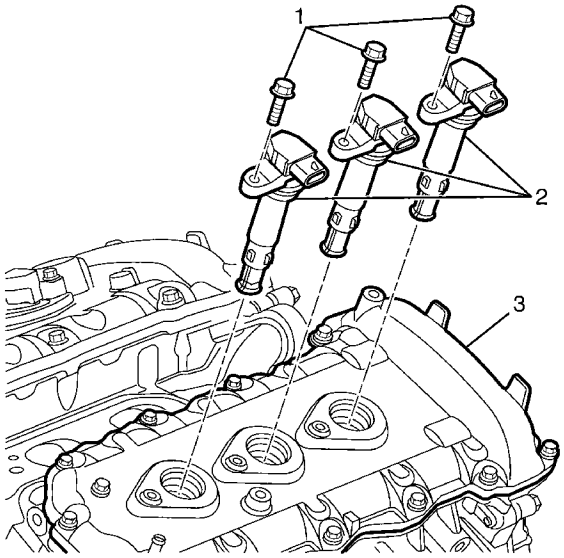
Note: Make sure the sealing surfaces of the cylinder head and camshaft cover are clean.

2. Place a 3mm bead of RTV sealant (1) on the join line between the engine front cover and the cylinder head.



3. Remove the EN 46101 EN 46101 (1) from the spark plug tubes of the left cylinder head.

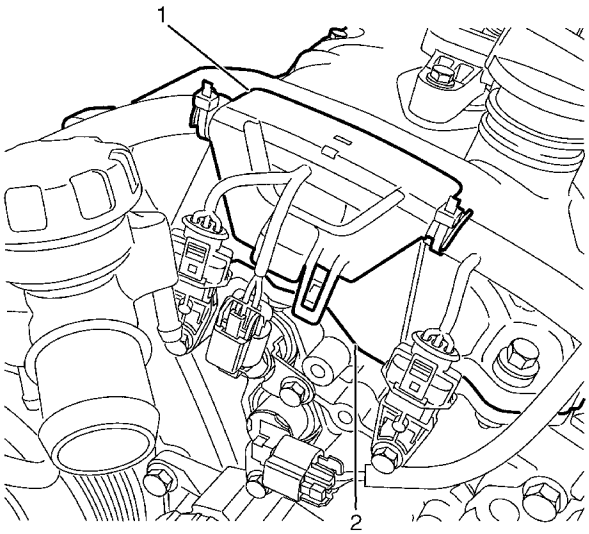
Install the camshaft cover. Refer to Camshaft Cover Installation - Left Side.



4. Install the ignition coils (2) to the camshaft cover (3).

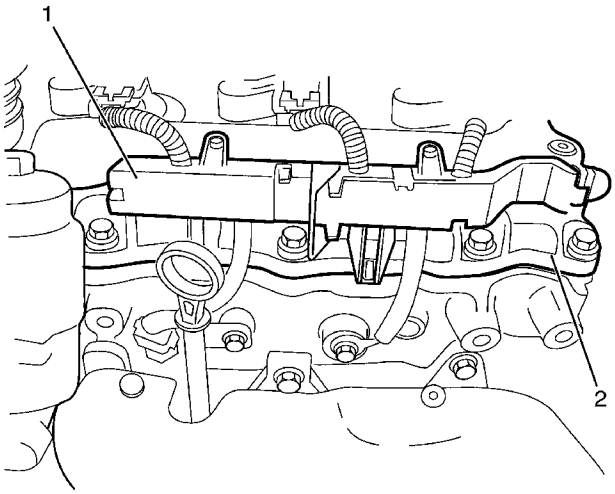
Caution: Refer to Fastener Caution in the Preface section.

5. Install the ignition coil to the camshaft cover retaining bolts (1) and tighten to **10 N·m (89 lb in)**.



Note: Make sure the wiring harness (1) is located on the camshaft cover (2) locating lugs and the clips are engaged.

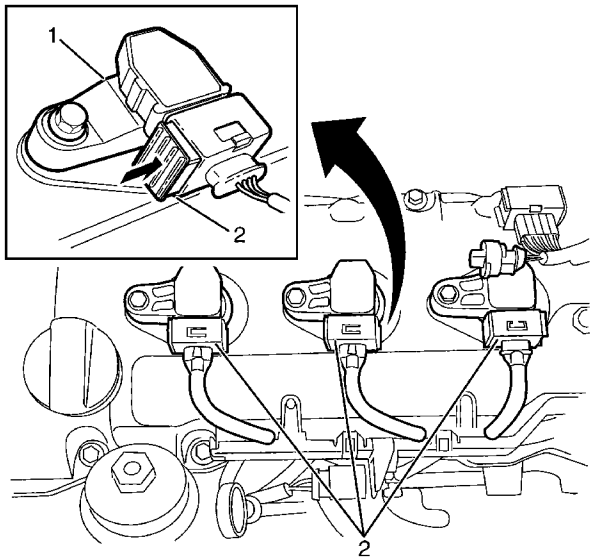
6. Install the wiring harness (1) to the front of the camshaft cover (2).



Note: Make sure the wiring harness (1) is located on the camshaft cover (2) locating lugs and the clips are engaged.

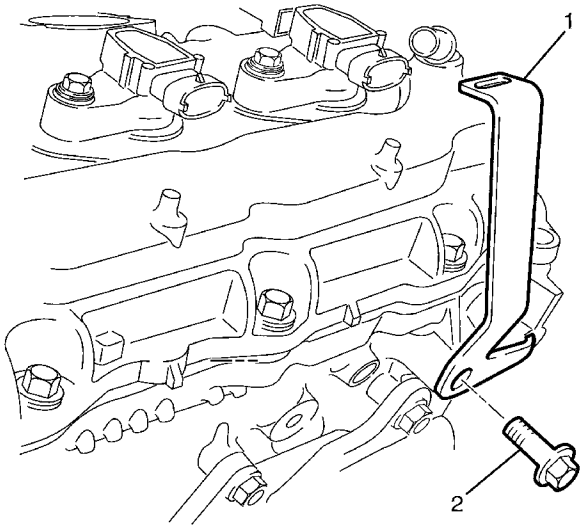
Note: Install the wiring harness from the side of the camshaft cover by sliding the conduit up and inboard.

7. Install the wiring harness (1) to the camshaft cover (2).



Note: Slide the connector retaining latch (2) in the direction of the arrow.

8. Connect the ignition coil electrical connectors (1).



9. Install the engine covers mounting bracket using the cylinder head retaining bolt (1) and tighten to **5 N·m (26 lb ft)**.
10. Install the engine covers mounting bracket (2).
11. Install the upper intake manifold with the lower intake manifold. Refer to Lower Intake Manifold Replacement.
12. Install the engine covers. Refer to Engine Cover Replacement.

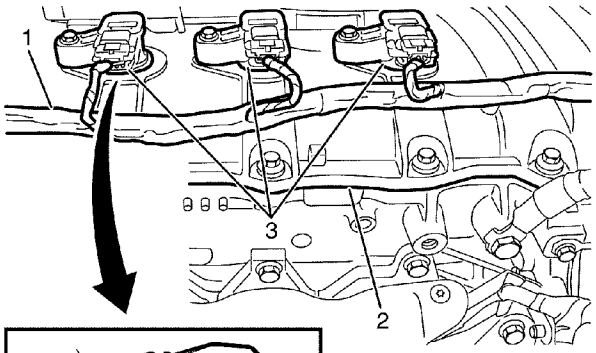
Camshaft Cover Replacement - Right Side

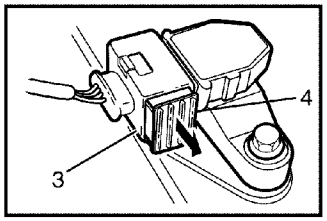
Special Tools

EN 46101 Spark Plug Tube Plugs

Removal Procedure

1. Remove the engine covers. Refer to Engine Cover Replacement.
2. Remove the upper intake manifold with the lower intake manifold. Refer to Lower Intake Manifold Replacement.





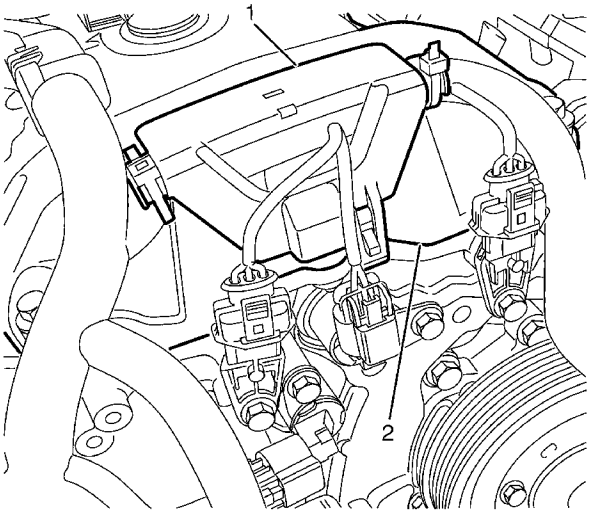
Note: Use a suitable tool to slide the connector retaining latch (4) in the direction of the arrow.

3. Disconnect the ignition coil electrical connectors (3).

Note: Use a suitable tool to detach the wiring harness (1) clips from the camshaft cover (2).

4. Remove the wiring harness (1) from the camshaft cover (2).

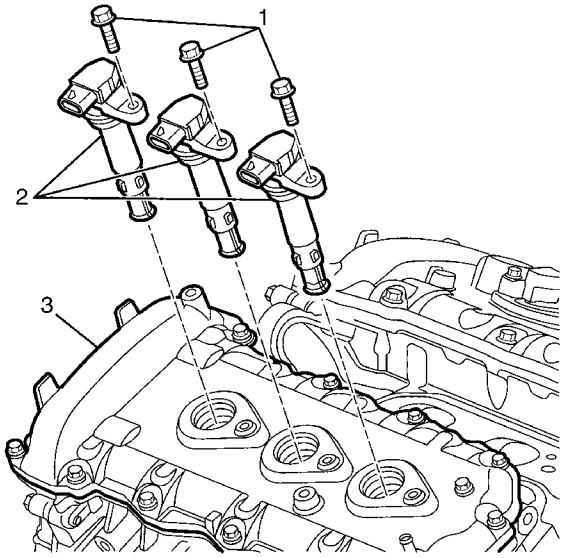
© 2010 General Motors Corporation. All rights reserved.



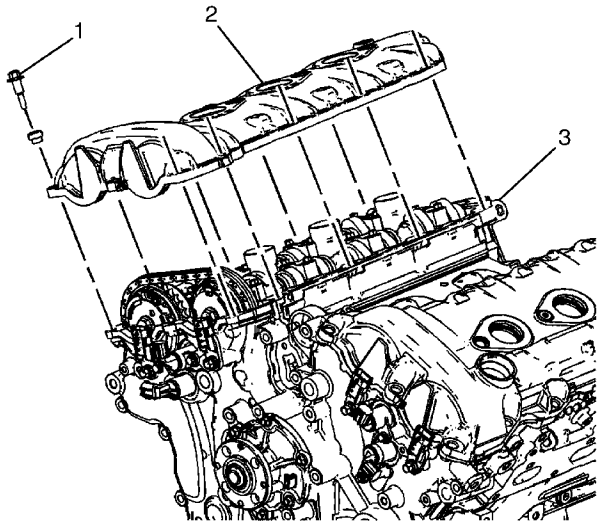
Note: It is not necessary to disconnect the engine front cover electrical connectors.

Note: Use a suitable tool to detach the wiring harness (1) clip from the camshaft cover (2), then lift the wiring harness (1) upwards to detach from the camshaft cover (2).

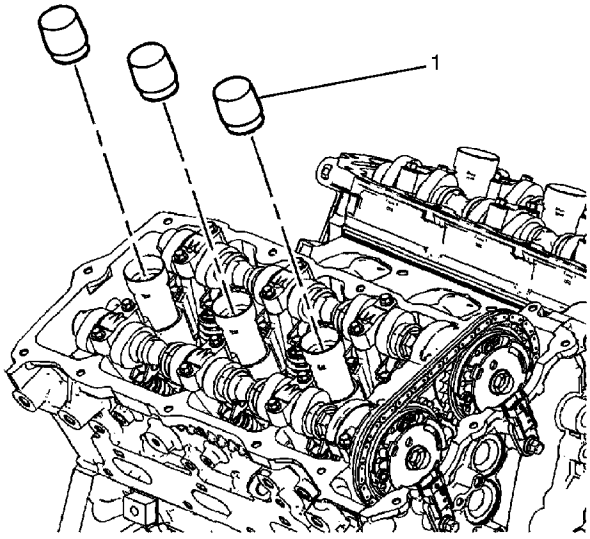
5. Remove the wiring harness (1) from the front of the camshaft cover (2).
6. Reposition and secure the wiring harness (1) away from the camshaft cover (2) in order to provide clearance for removal of the camshaft cover (2).



7. Remove the ignition coil to camshaft cover retaining bolts (1).
8. Remove the ignition coils (2) from the camshaft cover (3).

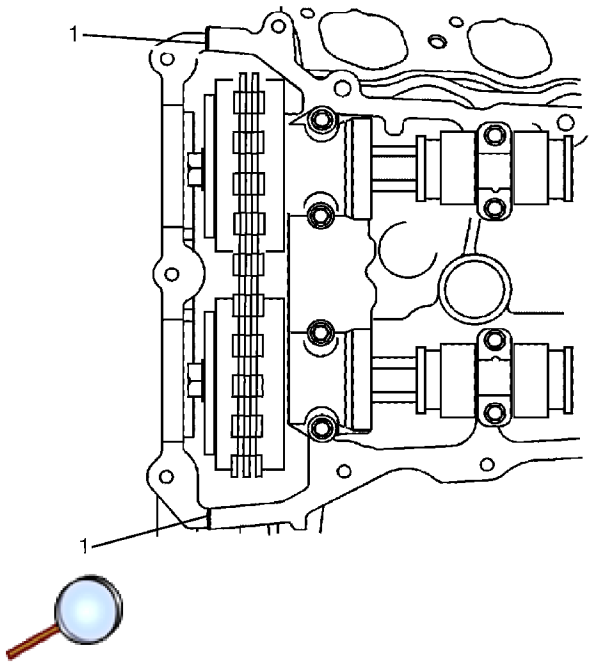


9. Remove the camshaft cover to cylinder head retaining bolts (1).
10. Remove the camshaft cover (2) from the cylinder head (3).
11. Remove and discard the camshaft cover seal and grommets.



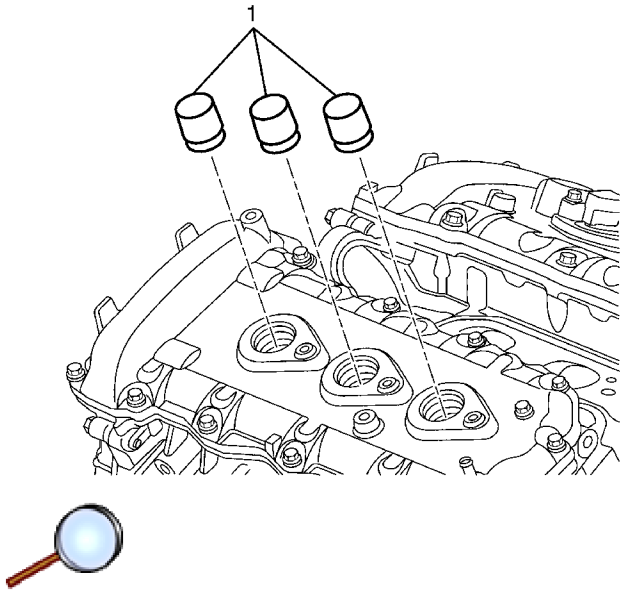
12. Install the EN-46101 (1) to the spark plug tubes to prevent dirt and other contaminants from entering the cylinders.

Installation Procedure

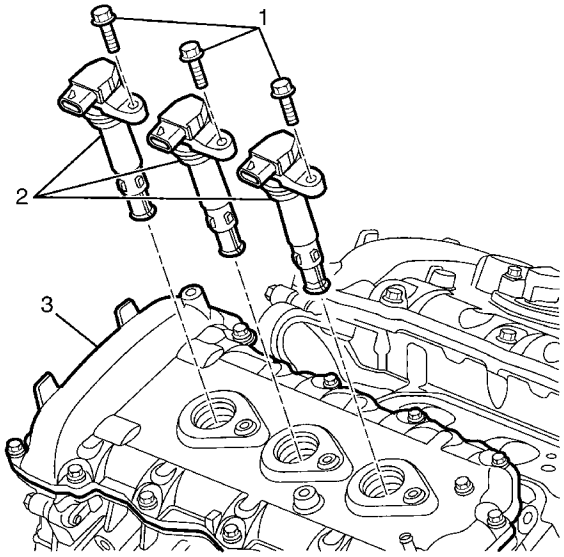


Note: Make sure the sealing surfaces of the cylinder head and camshaft cover are clean.

1. Place a 3mm bead of RTV sealant (1) on the join line between the engine front cover and the cylinder head.
2. Install a NEW camshaft cover seal and NEW grommets.
3. Install the camshaft cover. Refer to Camshaft Cover Installation - Right Side.



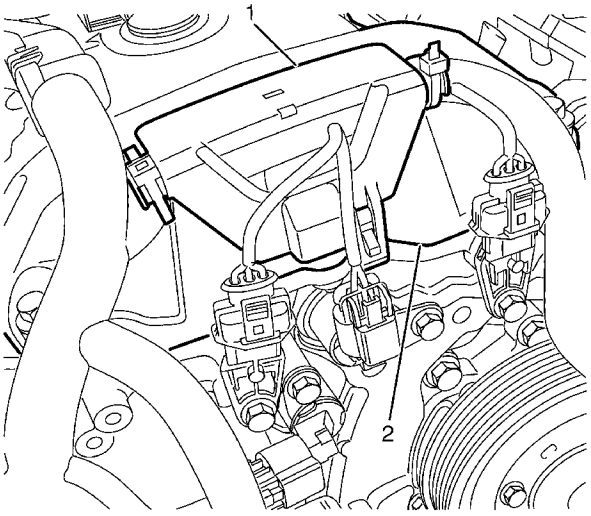
4. Remove the EN-46101 (1).



5. Install the ignition coils (2) to the camshaft cover (3).

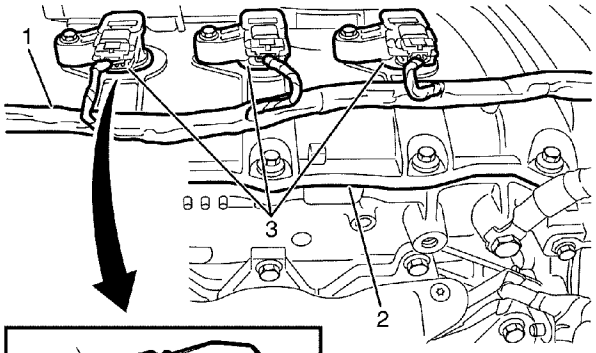
Caution: Refer to Fastener Caution in the Preface section.

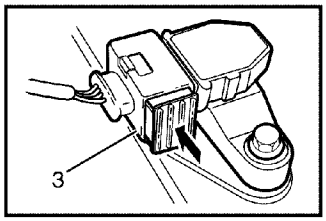
6. Install the ignition coil using the camshaft cover retaining bolts (1) and tighten to **10 N·m (89 lb in)**.



Note: Make sure the wiring harness (1) is located on the camshaft cover (2) locating lugs and the clips are engaged.

7. Install the wiring harness (1) to the front of the camshaft cover (2).





Note: Make sure the wiring harness (1) is located on the camshaft cover (2) locating lugs and the clips are engaged.

8. Install the wiring harness (1) to the camshaft cover (2).

Note: Slide the connector retaining latch (4) in the opposite direction of the arrow.

9. Connect the ignition coil electrical connectors (1).
10. Install the upper intake manifold with the lower intake manifold. Refer to Lower Intake Manifold Replacement.
11. Install the engine covers. Refer to Engine Cover Replacement.

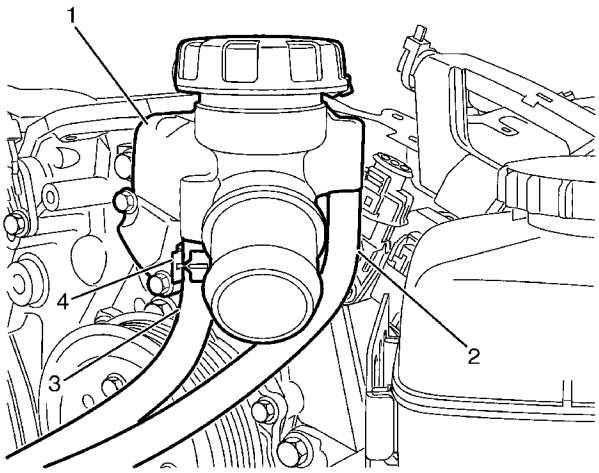
Engine Front Cover Replacement

Special Tools

EN 46109 Engine Front Cover Installation Guide Pins

Removal Procedure

1. Remove the engine covers. Refer to Engine Cover Replacement.
2. Remove the upper intake manifold with the lower intake manifold. Refer to Lower Intake Manifold Replacement.
3. Remove the camshaft covers. Refer to Camshaft Cover Replacement - Left Side and Camshaft Cover Replacement - Right Side.
4. Drain the engine coolant. Refer to Cooling System Draining and Filling.
5. Remove the radiator outlet hose. Refer to Radiator Outlet Hose Replacement.



6. Compress the coolant bleed hose retaining clamp (4) at the outlet housing (1) end and slide 50 mm (2 in) along the coolant bleed hose (3).
7. Remove the coolant bleed hose (3) from the outlet housing (1).

   Note: Twist and pull the coolant recovery hose (2) to remove from the outlet housing (1).

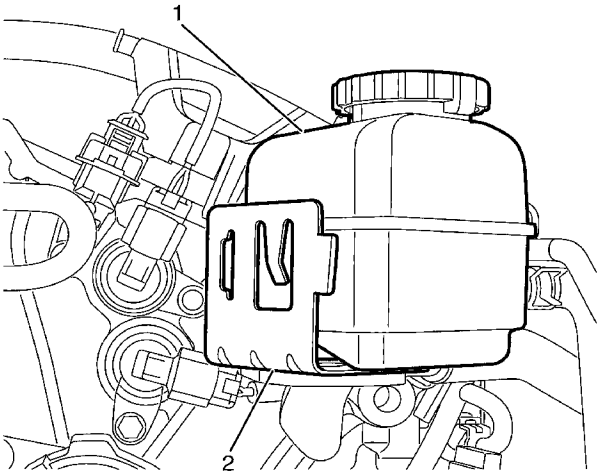
8. Disconnect the coolant recovery hose (2) from the outlet housing (1).

   Note: Plug or cap the hoses and inlets when separating the cooling system components, this prevents dirt and other contaminants from entering the cooling system.

9. Plug or cap the cooling system hoses and inlets
10. Remove the water outlet housing. Refer to Water Outlet Housing Replacement.
11. Remove the drive belt. Refer to Drive Belt Replacement.

© 2010 General Motors Corporation. All rights reserved.

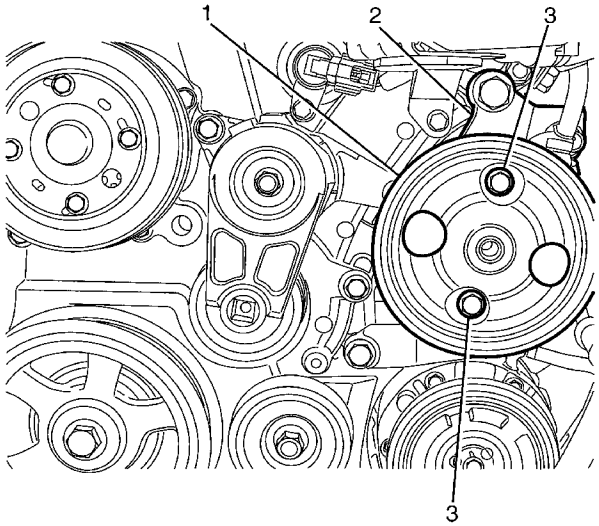
12. Remove the drive belt tensioner. Refer to Drive Belt Tensioner Replacement.
13. Remove the alternator bracket with the alternator. Refer to Generator Bracket Replacement.



Note: DO NOT disconnect the power steering pipes or drain the power steering fluid.

Note: The locking tang on the power steering reservoir bracket (2) must be released before removing the power steering reservoir (1). Release the locking tang on the power steering reservoir bracket (2) with a suitable tool.

14. Separate power steering fluid reservoir (1) from the power steering fluid reservoir bracket (2).
15. Reposition and secure the power steering fluid reservoir away from the power steering fluid reservoir (1) bracket (2).

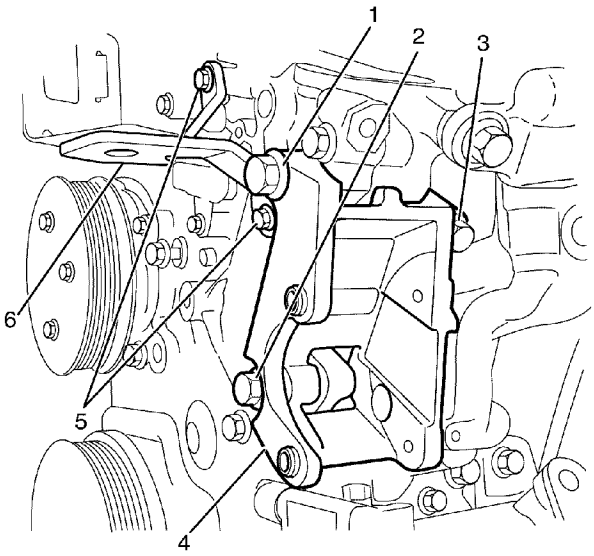


Note: DO NOT disconnect the power steering pipes/hoses.

Note: Bolts with micro-encapsulated thread sealant must be discarded after removal.

Note: Make sure all the bolt holes are thoroughly cleaned and all micro-encapsulated thread sealant is removed.

16. Remove the power steering pump to power steering bracket retaining bolts (3).
    - Discard the bolts.
    - Clean the bolt holes.
17. Remove the power steering pump (1) from the power steering bracket (2).
18. Secure and reposition the power steering pump (1) away from the power steering bracket (2).



Note: Bolts with micro-encapsulated thread sealant must be discarded after removal.

Note: Make sure all the bolt holes are thoroughly cleaned and all micro-encapsulated thread sealant is removed.

19. Remove the power steering fluid reservoir bracket to engine front cover retaining bolts (5).
    - Discard the bolts.
    - Clean the bolt holes.
20. Remove the power steering fluid reservoir bracket (6).

Note: Bolts with micro-encapsulated thread sealant must be discarded after removal.

Note: Make sure all the bolt holes are thoroughly cleaned and all micro-encapsulated thread sealant is removed.

21. Remove the power steering bracket to cylinder head retaining bolt (3).
    - Discard the bolt.

- Clean the bolt hole.

Note: Bolts with micro-encapsulated thread sealant must be discarded after removal.

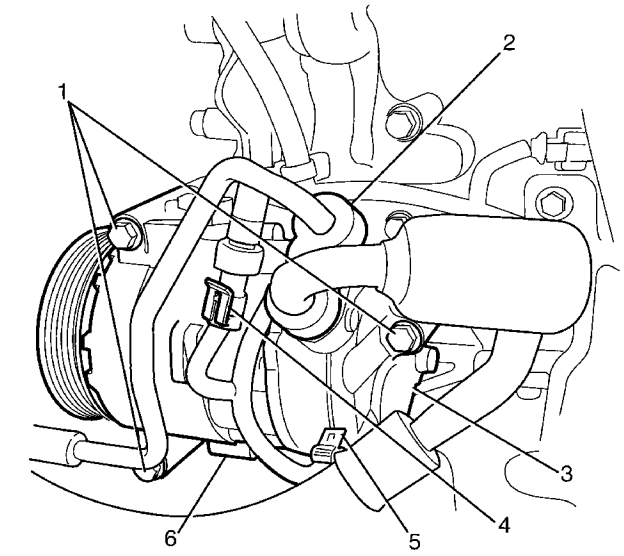
Note: Make sure all the bolt holes are thoroughly cleaned and all micro-encapsulated thread sealant is removed.

22. Remove the power steering bracket to engine front cover retaining bolt (1).
    - Discard the bolt.
    - Clean the bolt hole.

Note: Bolts with micro-encapsulated thread sealant must be discarded after removal.

Note: Make sure all the bolt holes are thoroughly cleaned and all micro-encapsulated thread sealant is removed.

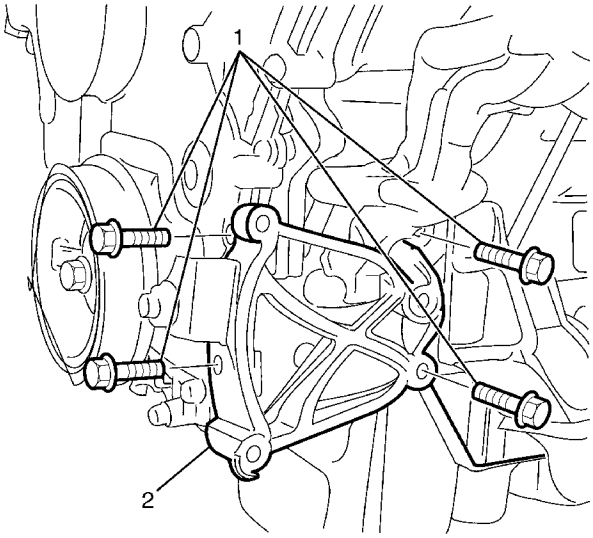
23. Remove the power steering bracket to cylinder block retaining bolt (2).
    - Discard the bolt.
    - Clean the bolt hole.
24. Remove the power steering pump bracket (4).



25. Disconnect the A/C pressure transducer electrical connector (4).
26. Disconnect the A/C compressor electrical connector (5).

Note: DO NOT disconnect the A/C pipes (2) from the A/C compressor (6).

27. Remove the A/C compressor to A/C compressor/power steering pump mounting bracket retaining bolts (1).
28. Secure and reposition the A/C compressor (6) away from the A/C compressor mounting bracket (3).



29. Remove the compressor bracket mounting bolts (1).
30. Remove the compressor bracket (2).
31. Remove the crankshaft balancer. Refer to Crankshaft Balancer Replacement.
32. Remove the camshaft position sensors. Refer to (if fitted) Camshaft Position Sensor Replacement - Bank 2 (Left Side) Exhaust. Refer to (if fitted) Camshaft Position Sensor Replacement - Bank 1 (Right Side) Exhaust and Camshaft Position Sensor Replacement - Bank 2 (Left Side) Intake. Refer to Camshaft Position Sensor Replacement - Bank 1 (Right Side) Intake.
33. Remove the camshaft position (CMP) actuator solenoids. Refer to (if fitted) Camshaft Position Actuator Solenoid Valve Solenoid Replacement - Bank 2 (Left Side) Exhaust and Camshaft Position Actuator Solenoid Valve Solenoid Replacement - Bank 2 (Left Side) Intake (if fitted) Camshaft Position Actuator Replacement - Bank 1 (Right Side) Exhaust and Camshaft Position Actuator Replacement - Bank 1 (Right Side) Intake.
34. Remove the engine front cover with the water pump. Refer to Engine Front Cover Removal.
35. Disassemble the engine front cover as necessary. Refer to Engine Front Cover Disassemble.

Note: DO NOT use sharp and/or metal gasket scrapers in order to clean the sealing surfaces.

36. Carefully clean the engine front cover sealing surfaces. Refer to Engine Front Cover Cleaning and Inspection.

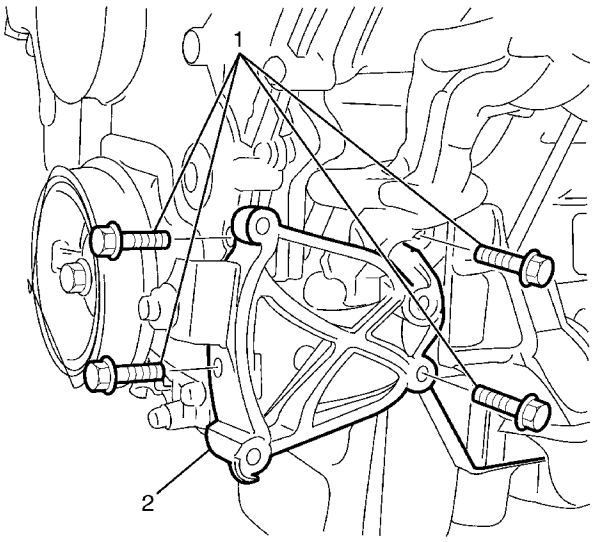
Note: Insert a piece of cardboard between the oil pan front and the oil pump in order to prevent any contaminants from falling into the oil pan.

37. Carefully clean the engine front cover sealing surfaces. Refer to Engine Front Cover Cleaning and Inspection.
38. Use compressed air in order to remove any engine coolant from the engine cooling passages and from the top of the oil pan scraper (windage tray).

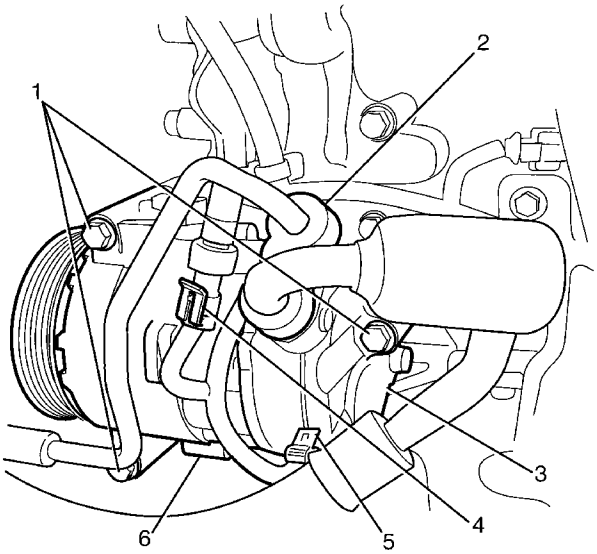
Installation Procedure

1. Assemble the engine front cover as necessary. Refer to Engine Front Cover Assemble.
2. Use the EN 46109 to install the engine front cover. Refer to Engine Front Cover Installation.

3. Install the camshaft position (CMP) actuator solenoids. Refer to (if fitted) Camshaft Position Actuator Solenoid Valve Solenoid Replacement - Bank 2 (Left Side) Exhaust and Camshaft Position Actuator Solenoid Valve Solenoid Replacement - Bank 2 (Left Side) Intake. Refer to (if fitted) Camshaft Position Actuator Replacement - Bank 1 (Right Side) Exhaust and Camshaft Position Actuator Replacement - Bank 1 (Right Side) Intake.
4. Install the camshaft position sensors. Refer to (if fitted) Camshaft Position Sensor Replacement - Bank 2 (Left Side) Exhaust and Camshaft Position Sensor Replacement - Bank 2 (Left Side) Intake. Refer to (if fitted) Camshaft Position Sensor Replacement - Bank 1 (Right Side) Exhaust and Camshaft Position Sensor Replacement - Bank 1 (Right Side) Intake.
5. Install the crankshaft balancer. Refer to Crankshaft Balancer Replacement.



6. install the compressor bracket (2).
7. Install the compressor bracket mounting bolts (1).

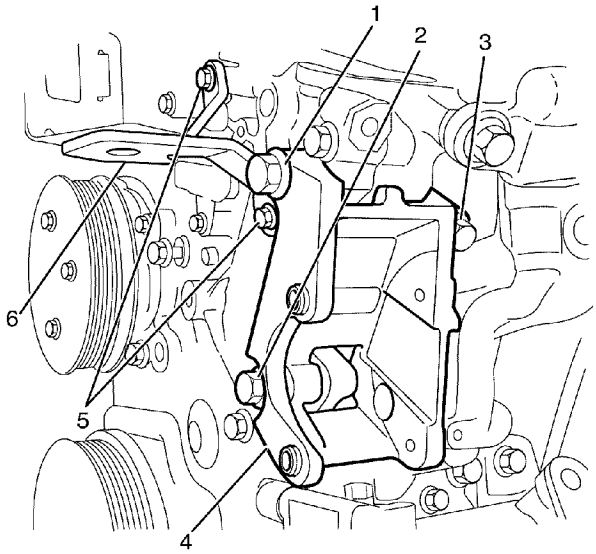


Note: Make sure the A/C pipes (2) are not twisted or kinked upon compressor installation.

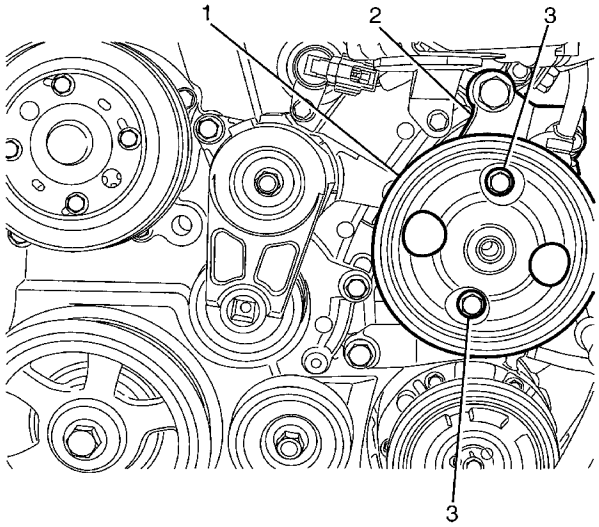
8. Install the A/C compressor (6) with the A/C pipes (2) to the A/C compressor mounting bracket (3).

Caution: Refer to Fastener Caution in the Preface section.

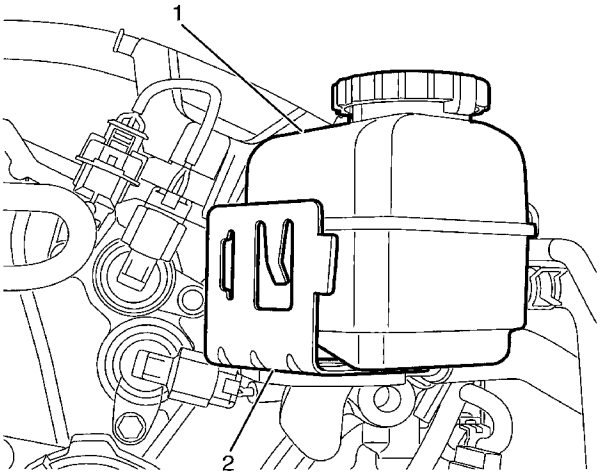
9. Install the compressor to the compressor mounting bracket retaining bolts (1) and tighten to **22 N·m (16 lb ft)**
10. Connect the A/C pressure transducer electrical connector (4).
11. Connect the A/C compressor electrical connector (5).



12. Install the power steering pump bracket (4).
13. Install a NEW power steering bracket to the cylinder head retaining bolt (3) and tighten to **58 N·m (43 lb ft)**.
14. Install a NEW power steering bracket to the engine front cover retaining bolts (1) and tighten to **58 N·m (43 lb ft)**.
15. Install a NEW power steering bracket to the cylinder block retaining bolt (2) and tighten to **58 N·m (43 lb ft)**.
16. Install the power steering fluid reservoir bracket (6).
17. Install the NEW power steering fluid reservoir bracket to the engine front cover retaining bolts (5) and tighten to **9 N·m (80 lb ft)**.

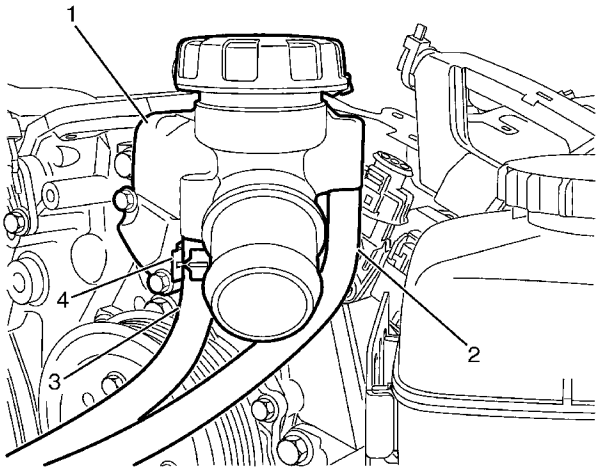


18. Install the power steering pump (2) to the power steering pump bracket (1).
19. Install the NEW power steering pump to the power steering pump bracket retaining bolts (3) and tighten to **27 N·m (22 lb ft)**.



Note: Make sure the power steering reservoir (1) and the locking tang on the power steering reservoir bracket (2) are engaged to avoid an induced rattle condition.

20. Install the power steering fluid reservoir (1) to the power steering fluid reservoir bracket (2).
21. Install the alternator bracket with the alternator. Refer to Generator Bracket Replacement.
22. Install the belt tensioner. Refer to Drive Belt Tensioner Replacement.
23. Install the drive belt. Refer to Drive Belt Replacement.
24. Install the water outlet housing. Refer to Water Outlet Housing Replacement.



25. Remove the plug or cap at the cooling system hoses and inlets
26. Install the coolant bleed hose (3) to the outlet housing (1).
27. Compress the coolant bleed hose retaining clamp (4) and position back to its original location on the coolant bleed hose (3).
28. Connect the coolant recovery hose (2) from the outlet housing (1).
29. Install the radiator outlet hose. Refer to Radiator Outlet Hose Replacement.
30. Install the camshaft covers. Refer to Camshaft Cover Replacement - Left Side and Camshaft Cover Replacement - Right Side.
31. Install the upper intake manifold with the lower intake manifold. Refer to Lower Intake Manifold Replacement.
32. Install the engine covers. Refer to Engine Cover Replacement.
33. Fill the cooling system. Refer to Cooling System Draining and Filling.
34. Change the engine oil. Refer to Engine Oil and Oil Filter Replacement.

Secondary Camshaft Drive Chain Replacement - Left Side

Removal Procedure

1. Remove the engine covers. Refer to Engine Cover Replacement .
2. Remove the spark plugs in order to ease crankshaft/engine rotation. Refer to Spark Plug Replacement .
3. Remove the engine front cover. Refer to Engine Front Cover Replacement .
4. Remove the right bank secondary camshaft drive chain tensioner. Refer to Secondary Camshaft Drive Chain Tensioner Removal - Right Side .
5. Remove the right bank secondary camshaft drive chain shoe. Refer to Secondary Camshaft Drive Chain Shoe Removal - Right Side .
6. Remove the right bank secondary camshaft drive chain guide. Refer to Secondary Camshaft Drive Chain Guide Removal - Right Side .
7. Remove the right bank secondary camshaft drive chain. Refer to Secondary Camshaft Drive Chain Removal - Right Side .
8. Remove the primary camshaft drive chain tensioner. Refer to Primary Camshaft Intermediate Drive Chain Tensioner Removal .
9. Remove the primary upper camshaft drive chain guide. Refer to Primary Timing Chain Guide Removal - Upper .
10. Remove the primary camshaft drive chain. Refer to Primary Camshaft Intermediate Drive Chain Removal .
11. Remove the right bank camshaft intermediate drive chain idler. Refer to Camshaft Intermediate Drive Chain Idler Removal - Right Side .
12. Remove the left bank secondary camshaft drive chain tensioner. Refer to Secondary Camshaft Drive Chain Tensioner Removal - Left Side .
13. Remove the left bank secondary camshaft drive chain shoe. Refer to Secondary Camshaft Drive Chain Shoe Removal - Left Side .
14. Remove the left bank secondary camshaft drive chain guide. Refer to Secondary Camshaft Drive Chain Guide Removal - Left Side .
15. Remove the left bank camshaft intermediate drive chain idler. Refer to Camshaft Intermediate Drive Chain Idler Removal - Left Side .
16. Remove the left bank secondary camshaft drive chain. Refer to Secondary Camshaft Drive Chain Removal - Left Side .
17. Clean and inspect all of the camshaft timing drive components. Refer to Camshaft Timing Drive Components Cleaning and Inspection .

Installation Procedure

1. Install the left bank secondary camshaft drive chain. Refer to Secondary Camshaft Drive Chain Installation - Left Side .
2. Install the left bank camshaft intermediate drive chain idler. Refer to Camshaft Intermediate Drive Chain Idler Installation - Left Side .
3. Install the left bank secondary camshaft drive chain guide. Refer to Secondary Camshaft Drive Chain Guide Installation - Left Side .
4. Install the left bank secondary camshaft drive chain shoe. Refer to Secondary Camshaft Drive Chain Shoe Installation - Left Side .
5. Install the left bank secondary camshaft drive chain tensioner. Refer to Secondary Camshaft Drive Chain Tensioner Installation - Left Side .
6. Install the right bank camshaft intermediate drive chain idler. Refer to Camshaft

© 2010 General Motors Corporation. All rights reserved.

Intermediate Drive Chain Idler Installation - Right Side .

7. Install the primary camshaft drive chain. Refer to Primary Camshaft Intermediate Drive Chain Installation .
8. Install the primary upper camshaft drive chain guide. Refer to Primary Timing Chain Guide Installation - Upper .
9. Install the primary camshaft drive chain tensioner. Refer to Primary Camshaft Intermediate Drive Chain Tensioner Removal .
10. Install the right bank secondary camshaft drive chain. Refer to Secondary Camshaft Drive Chain Installation - Right Side .
11. Install the right bank secondary camshaft drive chain guide. Refer to Secondary Camshaft Drive Chain Guide Installation - Right Side .
12. Install the right bank secondary camshaft drive chain shoe. Refer to Secondary Camshaft Drive Chain Shoe Installation - Right Side .
13. Install the right bank secondary camshaft drive chain tensioner. Refer to Secondary Camshaft Drive Chain Shoe Installation - Right Side .
14. Install the spark plugs. Refer to Spark Plug Replacement .
15. Install the engine front cover. Refer to Engine Front Cover Replacement .
16. Install the engine covers. Refer to Engine Cover Replacement .

Secondary Camshaft Drive Chain Replacement - Right Side

Removal Procedure

1. Remove the engine covers. Refer to Engine Cover Replacement .
2. Remove the spark plugs in order to ease crankshaft/engine rotation. Refer to Spark Plug Replacement .
3. Remove the engine front cover. Refer to Engine Front Cover Replacement .
4. Remove the right bank secondary camshaft drive chain tensioner. Refer to Secondary Camshaft Drive Chain Tensioner Removal - Right Side .
5. Remove the right bank secondary camshaft drive chain shoe. Refer to Secondary Camshaft Drive Chain Shoe Removal - Right Side .
6. Remove the right bank secondary camshaft drive chain guide. Refer to Secondary Camshaft Drive Chain Guide Removal - Right Side .
7. Remove the right bank secondary camshaft drive chain. Refer to Secondary Camshaft Drive Chain Removal - Right Side .

Installation Procedure

1. Install the right bank secondary camshaft drive chain. Refer to Secondary Camshaft Drive Chain Installation - Right Side .
2. Install the right bank secondary camshaft drive chain guide. Refer to Secondary Camshaft Drive Chain Guide Installation - Right Side .
3. Install the right bank secondary camshaft drive chain shoe. Refer to Secondary Camshaft Drive Chain Shoe Installation - Right Side .
4. Install the right bank secondary camshaft drive chain tensioner. Refer to Secondary Camshaft Drive Chain Shoe Installation - Right Side .
5. Install the spark plugs. Refer to Spark Plug Replacement .
6. Install the engine front cover. Refer to Engine Front Cover Replacement .
7. Install the engine covers. Refer to Engine Cover Replacement .

© 2010 General Motors Corporation. All rights reserved.

Secondary Camshaft Drive Chain Tensioner Replacement - Left Side

Removal Procedure

1. Remove the engine covers. Refer to Engine Cover Replacement .
2. Remove the spark plugs in order to ease crankshaft/engine rotation. Refer to Spark Plug Replacement .
3. Remove the engine front cover. Refer to Engine Front Cover Replacement .
4. Remove the left bank secondary camshaft drive chain tensioner. Refer to Secondary Camshaft Drive Chain Tensioner Removal - Left Side .

Installation Procedure

1. Install the left bank secondary camshaft drive chain tensioner. Refer to Secondary Camshaft Drive Chain Tensioner Installation - Left Side .
2. Install the spark plugs. Refer to Spark Plug Replacement .
3. Install the engine front cover. Refer to Engine Front Cover Replacement .
4. Install the engine covers. Refer to Engine Cover Replacement .

© 2010 General Motors Corporation. All rights reserved.

Secondary Camshaft Drive Chain Tensioner Replacement - Right Side

Removal Procedure

1. Remove the spark plugs in order to ease crankshaft/engine rotation. Refer to Spark Plug Replacement .
2. Remove the engine front cover. Refer to Engine Front Cover Replacement .
3. Remove the right bank secondary camshaft drive chain tensioner. Refer to Secondary Camshaft Drive Chain Tensioner Removal - Right Side .

Installation Procedure

1. Install the right bank secondary camshaft drive chain tensioner. Refer to Secondary Camshaft Drive Chain Shoe Installation - Right Side .
2. Install the spark plugs. Refer to Spark Plug Replacement .
3. Install the engine front cover. Refer to Engine Front Cover Replacement .
4. Install the engine covers. Refer to Engine Cover Replacement .

© 2010 General Motors Corporation. All rights reserved.

Secondary Camshaft Drive Chain Shoe Replacement - Left Side

Removal Procedure

1. Remove the engine covers. Refer to Engine Cover Replacement .
2. Remove the spark plugs in order to ease crankshaft/engine rotation. Refer to Spark Plug Replacement .
3. Remove the engine front cover. Refer to Engine Front Cover Replacement .
4. Remove the left bank secondary camshaft drive chain shoe. Refer to Secondary Camshaft Drive Chain Shoe Removal - Left Side .

Installation Procedure

1. Install the left bank secondary camshaft drive chain shoe. Refer to Secondary Camshaft Drive Chain Shoe Installation - Left Side .
2. Install the spark plugs. Refer to Spark Plug Replacement .
3. Install the engine front cover. Refer to Engine Front Cover Replacement .
4. Install the engine covers. Refer to Engine Cover Replacement .

© 2010 General Motors Corporation. All rights reserved.

Secondary Camshaft Drive Chain Shoe Replacement - Right Side

Removal Procedure

1. Remove the engine covers. Refer to Engine Cover Replacement .
2. Remove the spark plugs in order to ease crankshaft/engine rotation. Refer to Spark Plug Replacement .
3. Remove the engine front cover. Refer to Engine Front Cover Replacement .
4. Remove the right bank secondary camshaft drive chain tensioner. Refer to Secondary Camshaft Drive Chain Tensioner Removal - Right Side .
5. Remove the right bank secondary camshaft drive chain shoe. Refer to Secondary Camshaft Drive Chain Shoe Removal - Right Side .

Installation Procedure

1. Install the right bank secondary camshaft drive chain shoe. Refer to Secondary Camshaft Drive Chain Shoe Installation - Right Side .
2. Install the right bank secondary camshaft drive chain tensioner. Refer to Secondary Camshaft Drive Chain Tensioner Removal - Right Side .
3. Install the spark plugs. Refer to Spark Plug Replacement .
4. Install the engine front cover. Refer to Engine Front Cover Replacement .
5. Install the engine covers. Refer to Engine Cover Replacement .

© 2010 General Motors Corporation. All rights reserved.

Secondary Camshaft Drive Chain Guide Replacement - Left Side

Removal Procedure

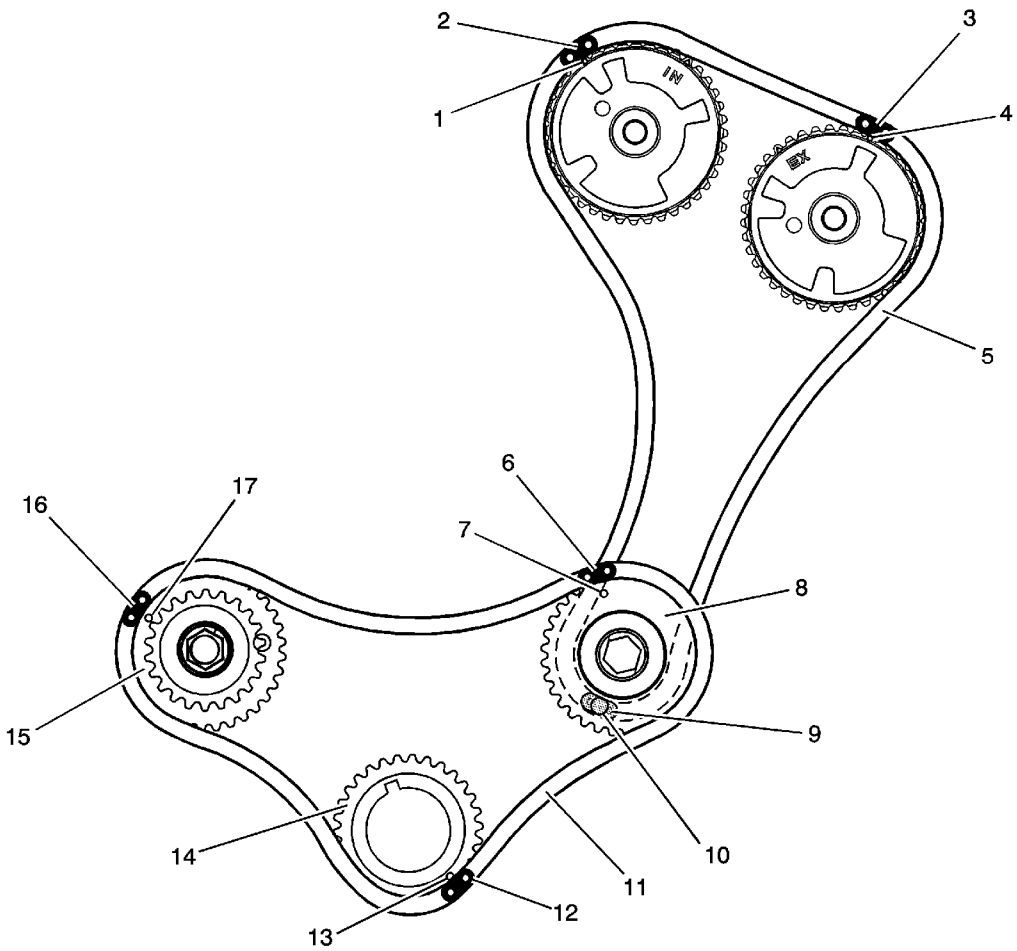
1. Remove the engine covers. Refer to Engine Cover Replacement .
2. Remove the spark plugs in order to ease crankshaft/engine rotation. Refer to Spark Plug Replacement .
3. Remove the engine front cover. Refer to Engine Front Cover Replacement .
4. Remove the left bank secondary camshaft drive chain tensioner. Refer to Secondary Camshaft Drive Chain Tensioner Removal - Left Side .
5. Remove the left bank secondary camshaft drive chain guide. Refer to Secondary Camshaft Drive Chain Guide Removal - Left Side .

Installation Procedure

1. Install the left bank secondary camshaft drive chain guide. Refer to Secondary Camshaft Drive Chain Guide Installation - Left Side .
2. Install the left bank secondary camshaft drive chain tensioner. Refer to Secondary Camshaft Drive Chain Tensioner Installation - Left Side .
3. Install the spark plugs. Refer to Spark Plug Replacement .
4. Install the engine front cover. Refer to Engine Front Cover Replacement .
5. Install the engine covers. Refer to Engine Cover Replacement .

© 2010 General Motors Corporation. All rights reserved.

Stage One



(1) Left Intake Camshaft Position (CMP) Actuator Timing Mark - Circle
(2) Left Intake Secondary Camshaft Timing Drive Chain Timing Link
(3) Left Exhaust Secondary Camshaft Timing Drive Chain Timing Link
(4) Left Exhaust Camshaft Position (CMP) Actuator Timing Mark - Circle
(5) Left Secondary Camshaft Timing Drive Chain
(6) Primary Camshaft Drive Chain Timing Link for the Left Primary Camshaft Intermediate Drive Chain Sprocket
(7) Left Primary Camshaft Intermediate Drive Chain Sprocket Timing Mark for the Primary Camshaft Drive Chain
(8) Left Primary Camshaft Intermediate Drive Chain Sprocket
(9) Left Secondary Camshaft Timing Drive Chain Timing Link for the Left Primary Camshaft Intermediate Drive Chain Sprocket, behind hole in sprocket

© 2010 General Motors Corporation. All rights reserved.

(10) Left Primary Camshaft Intermediate Drive Chain Sprocket Timing Window for the Left Secondary Camshaft Timing Drive Chain Timing Link
(11) Primary Camshaft Drive Chain
(12) Primary Camshaft Drive Chain Timing Link for the Crankshaft Sprocket
(13) Crankshaft Sprocket Timing Mark
(14) Crankshaft Sprocket
(15) Right Primary Camshaft Intermediate Drive Chain Sprocket
(16) Primary Camshaft Drive Chain Timing Link for the Right Primary Camshaft Intermediate Drive Chain Sprocket
(17) Right Primary Camshaft Intermediate Drive Chain Sprocket Timing Mark

Secondary Camshaft Drive Chain Guide Replacement - Right Side

Removal Procedure

1. Remove the engine covers. Refer to Engine Cover Replacement .
2. Remove the spark plugs in order to ease crankshaft/engine rotation. Refer to Spark Plug Replacement .
3. Remove the engine front cover. Refer to Engine Front Cover Replacement .
4. Remove the right bank secondary camshaft drive chain tensioner. Refer to Secondary Camshaft Drive Chain Tensioner Removal - Right Side .
5. Remove the right bank secondary camshaft drive chain guide. Refer to Secondary Camshaft Drive Chain Guide Removal - Right Side .

Installation Procedure

1. Install the right bank secondary camshaft drive chain guide. Refer to Secondary Camshaft Drive Chain Guide Installation - Right Side .
2. Install the right bank secondary camshaft drive chain tensioner. Refer to Secondary Camshaft Drive Chain Tensioner Removal - Right Side .
3. Install the spark plugs. Refer to Spark Plug Replacement .
4. Install the engine front cover. Refer to Engine Front Cover Replacement .
5. Install the engine covers. Refer to Engine Cover Replacement .

© 2010 General Motors Corporation. All rights reserved.

Primary Camshaft Drive Chain Tensioner Replacement

Removal Procedure

1. Remove the engine covers. Refer to Engine Cover Replacement .
2. Remove the spark plugs in order to ease crankshaft/engine rotation. Refer to Spark Plug Replacement .
3. Remove the engine front cover. Refer to Engine Front Cover Replacement .

   Important: If the entire camshaft timing system is not in Stage 2, refer to Camshaft Timing Drive Chain Alignment Diagram , mark the timing chain and sprockets in order to ensure correct reassembly.

4. Remove the primary camshaft drive chain tensioner. Refer to Primary Camshaft Intermediate Drive Chain Tensioner Removal .

Installation Procedure

1. Install the primary camshaft drive chain tensioner. Refer to Primary Camshaft Intermediate Drive Chain Tensioner Removal .
2. Install the spark plugs. Refer to Spark Plug Replacement .
3. Install the engine front cover. Refer to Engine Front Cover Replacement .
4. Install the engine covers. Refer to Engine Cover Replacement .

© 2010 General Motors Corporation. All rights reserved.

Primary Camshaft Drive Chain Guide Replacement - Upper

Removal Procedure

1. Remove the engine covers. Refer to Engine Cover Replacement .
2. Remove the spark plugs in order to ease crankshaft/engine rotation. Refer to Spark Plug Replacement .
3. Remove the engine front cover. Refer to Engine Front Cover Replacement .
4. Remove the primary camshaft drive chain tensioner. Refer to Primary Camshaft Intermediate Drive Chain Tensioner Removal .
5. Remove the primary upper camshaft drive chain guide. Refer to Primary Timing Chain Guide Removal - Upper .

Installation Procedure

1. Install the primary upper camshaft drive chain guide. Refer to Primary Timing Chain Guide Installation - Upper .
2. Install the primary camshaft drive chain tensioner. Refer to Primary Camshaft Intermediate Drive Chain Tensioner Removal .
3. Install the spark plugs. Refer to Spark Plug Replacement .
4. Install the engine front cover. Refer to Engine Front Cover Replacement .
5. Install the engine covers. Refer to Engine Cover Replacement .

© 2010 General Motors Corporation. All rights reserved.

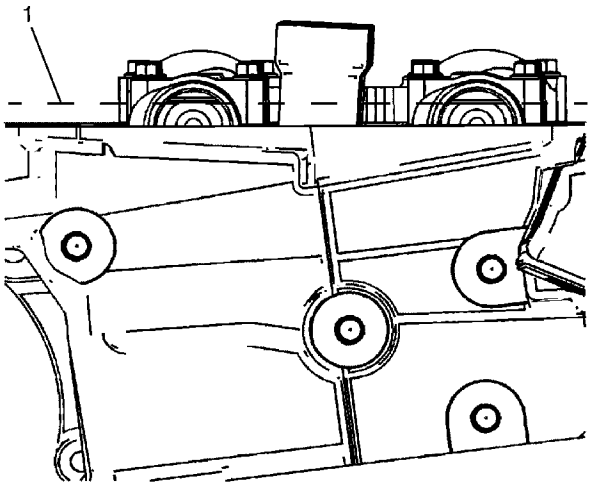
Camshaft Position Actuator Replacement - Bank 2 (Left Side) Exhaust

Special Tools

- EN 46105 Camshaft Locking Tools
- EN-48313 Timing Chain Retention Tool
- EN 46111 Crankshaft Rotation Socket

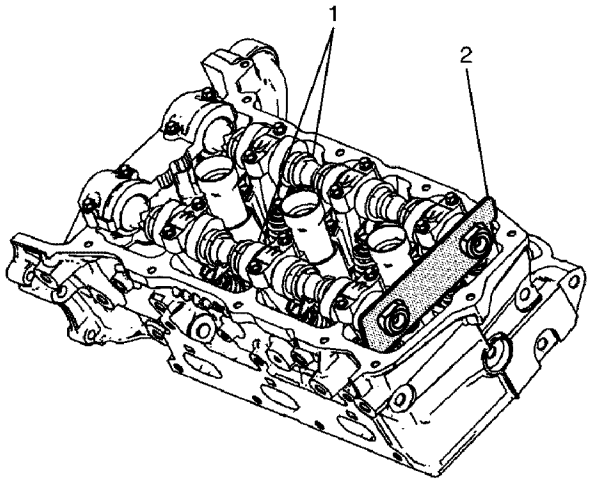
Removal Procedure

1. Remove the engine covers. Refer to Engine Cover Replacement.
2. Remove the upper intake manifold with the lower intake manifold. Refer to Lower Intake Manifold Replacement.
3. Remove the left side camshaft cover. Refer to Camshaft Cover Replacement - Left Side.
4. Remove the camshaft position sensors. Refer to (if fitted) Camshaft Position Sensor Replacement - Bank 2 (Left Side) Exhaust and Camshaft Position Sensor Replacement - Bank 2 (Left Side) Intake.
5. Remove the camshaft position (CMP) actuator solenoids. Refer to (if fitted) Camshaft Position Actuator Solenoid Valve Solenoid Replacement - Bank 2 (Left Side) Exhaust and Camshaft Position Actuator Solenoid Valve Solenoid Replacement - Bank 2 (Left Side) Intake.
6. Remove the crankshaft balancer. Refer to Crankshaft Balancer Removal.



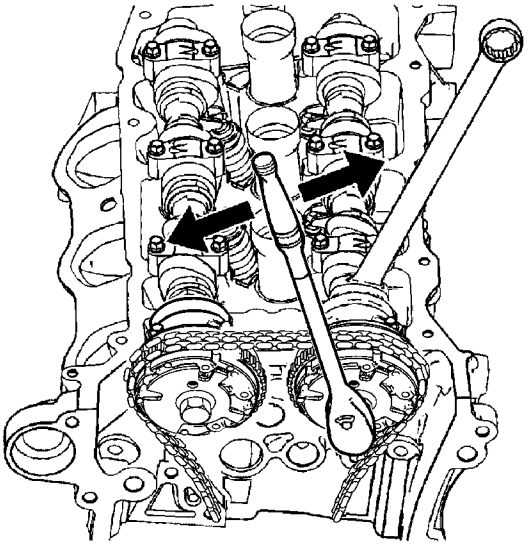
7. Rotate the crankshaft with the EN 46111 until the camshafts are in a neutral (low tension) position. The camshaft flats will be parallel with the camshaft cover rail (1).

© 2010 General Motors Corporation. All rights reserved.



8. Install the EN 46105 (2) onto the rear of the left side camshafts (1).

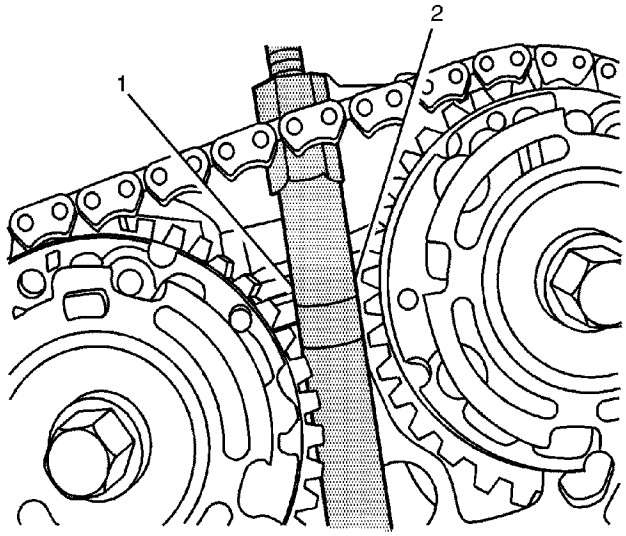
Caution: Refer to Torque Reaction Against Timing Drive Chain Caution in the Preface section.



Note:

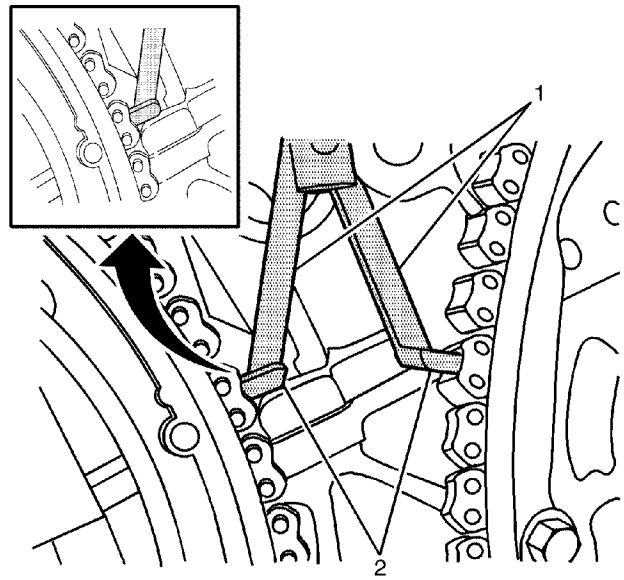
- Use an open-end wrench at the camshaft hex to prevent camshaft/engine rotation.
- DO NOT remove the camshaft position actuator to camshaft retaining bolt at this time.

9. Loosen the left side exhaust camshaft position actuator to camshaft retaining bolt.
10. Loosen the EN-48313 so that the legs are retracted.



Note: The front engine cover is removed in the following graphics for illustration purposes and is not required to perform the procedure.

11. Insert the EN-48313 between the camshaft actuators, rearward of the timing chain until the top line that is scribed in the body of the tool (1) is adjacent to the top surface of the cylinder head (2). This is the approximate installed position.



12. Make sure that the feet (2) on the legs (1) of the EN-48313 are facing the front of the engine.

Note: DO NOT tighten the EN-48313 at this stage.

13. Partially expand the legs (1) of EN-48313 by turning the T-shaped handle clockwise.

INote: Make sure that the feet (2) of the EN-48313 are correctly engaged into one of the link pockets to prevent chain slipping during tightening.

14. Continue expanding the EN-48313 until the feet (2) contact the timing chain.

Caution: Refer to Torque Reaction Against Timing Drive Chain Caution in the Preface section.

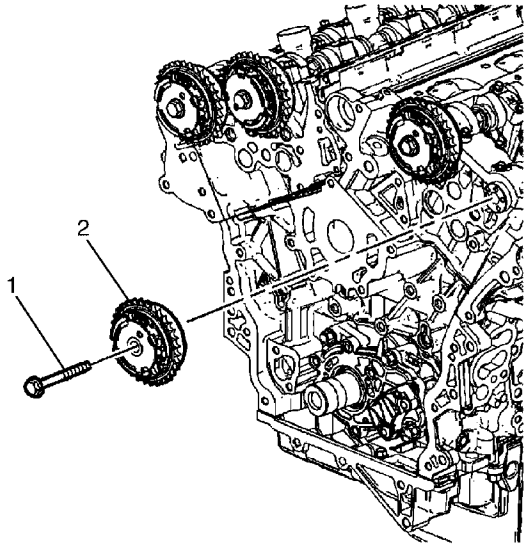
15. Hand tighten the EN-48313 .

Note: DO NOT allow the body of the EN-48313 to rotate when tightening the T-handle.

16. Use an open-end wench on the hex cast into the body of the EN-48313 and hand tighten the T-handle.
17. Use an open-end wrench on the hex cast of the left side intake and exhaust camshafts and rotate the camshafts towards each other in order create slack in the chain between the actuators.
18. The EN-48313 is now correctly installed to hold the timing chain in position.

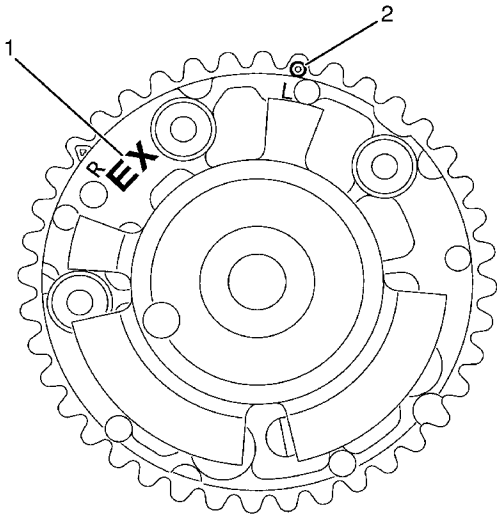
Note: Make sure that the camshaft timing chain and the camshaft position actuators are marked for correct assembly.

19. Mark the timing chain and the camshaft position actuators.

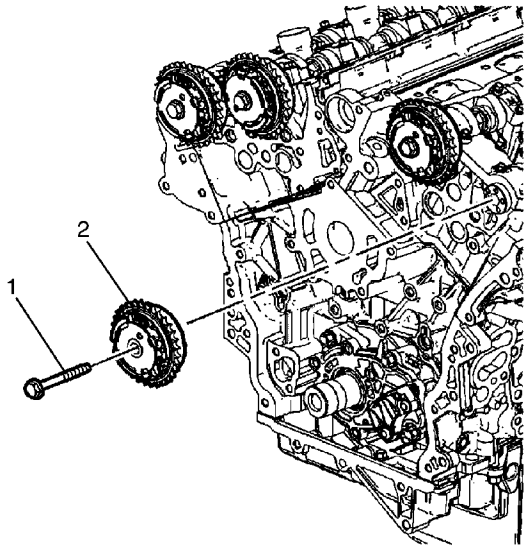


20. Remove the left side exhaust camshaft position actuator to camshaft retaining bolt (1).
21. Remove the left side exhaust camshaft position actuator (2).

Installation Procedure



1. Make sure the correct camshaft position actuator is installed. Observe the body of the camshaft position actuator for the "EX" marking (1). The marking is for an exhaust camshaft position actuator.
2. Make sure the correct timing mark is used. Observe the outer ring of the camshaft position actuator for the "L" and circle marking (2). The marking is for alignment to the highlighted timing chain link on the left side of the engine.



3. Install the left side exhaust camshaft position actuator (2).

Note:

- Make sure that the marks on the camshaft position actuators and the timing chain are aligned.
- DO NOT tighten the left side exhaust camshaft position actuator to camshaft retaining bolt (1) at this time.

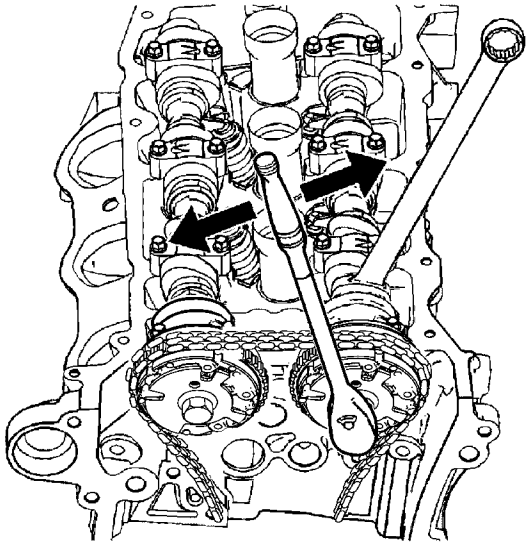
4. Install the camshaft position actuator to camshaft retaining bolt (1).

   DO NOT fully tighten at this stage.

5. Remove EN-48313 .

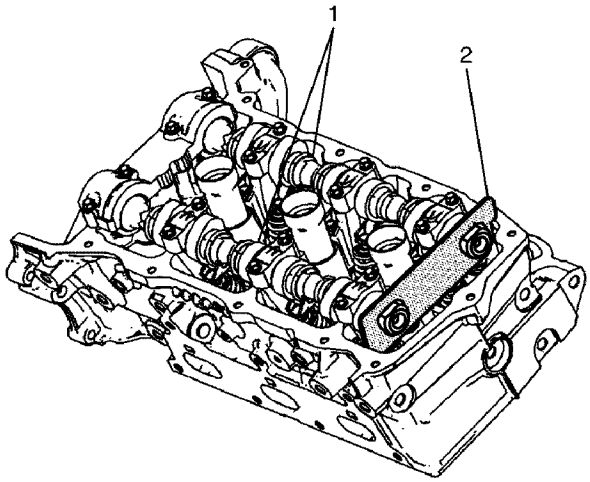
   Caution: Refer to Torque Reaction Against Timing Drive Chain Caution in the Preface section.

   Caution: Refer to Fastener Caution in the Preface section.



Note: Use an open-end wrench at the camshaft hex to prevent camshaft/engine rotation.

6. Install the camshaft position actuator using the camshaft retaining bolt and tighten to **58 N·m (43 lb ft)**.



7. Remove the EN 46105 (2) from the rear of the left side camshafts (1).
8. Install the camshaft position (CMP) actuator solenoids. Refer to (if fitted) Camshaft Position Actuator Solenoid Valve Solenoid Replacement - Bank 2 (Left Side) Exhaust and Camshaft Position Actuator Solenoid Valve Solenoid Replacement - Bank 2 (Left Side) Intake
9. Install the camshaft position sensors. Refer to (if fitted) Camshaft Position Sensor Replacement - Bank 2 (Left Side) Exhaust and Camshaft Position Sensor Replacement - Bank 2 (Left Side) Intake.
10. Install the crankshaft balancer. Refer to Crankshaft Balancer Installation.
11. Install the left bank camshaft cover. Refer to Camshaft Cover Replacement - Left Side.
12. Install the upper intake manifold with the lower intake manifold. Refer to Lower Intake Manifold Replacement.
13. Install the engine covers. Refer to Engine Cover Replacement.

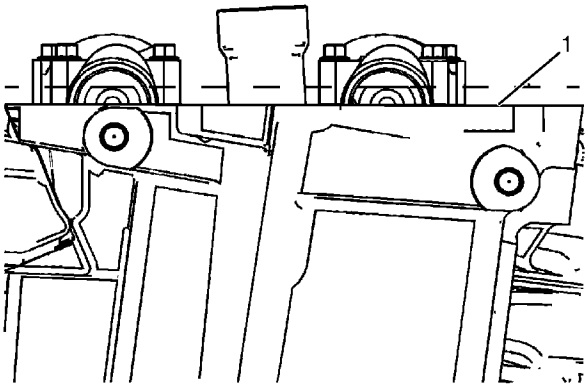
Camshaft Position Actuator Replacement - Bank 1 (Right Side) Exhaust

Tools Required

- EN 46105 Camshaft Locking Tools
- EN-48313 Timing Chain Retention Tool
- EN 46111 Crankshaft Rotation Socket

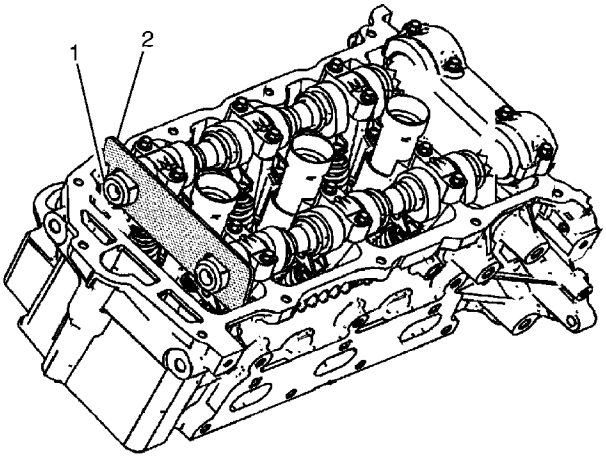
Removal Procedure

1. Remove the engine covers. Refer to Engine Cover Replacement.
2. Remove the upper intake manifold with the lower intake manifold. Refer to Lower Intake Manifold Replacement.
3. Remove the right side camshaft cover. Refer to Camshaft Cover Replacement - Right Side.
4. Remove the camshaft position sensors. Refer to Camshaft Position Sensor Replacement - Bank 1 (Right Side) Exhaust and Camshaft Position Sensor Replacement - Bank 1 (Right Side) Intake.
5. Remove the camshaft position (CMP) actuator solenoids. Refer to (if fitted) Camshaft Position Actuator Replacement - Bank 1 (Right Side) Exhaust and Camshaft Position Actuator Replacement - Bank 1 (Right Side) Intake.
6. Remove the crankshaft balancer. Refer to Crankshaft Balancer Removal.



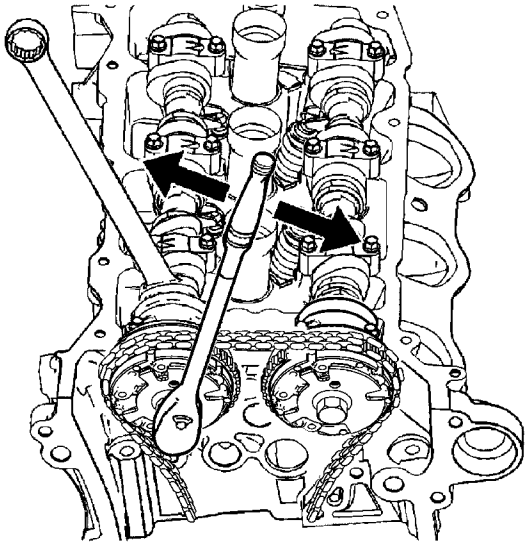
7. Rotate the crankshaft with the EN 46111 until the camshafts are in a neutral (low tension) position. The camshaft flats will be parallel with the camshaft cover rail (1).

© 2010 General Motors Corporation. All rights reserved.



8. Install the EN 46105 (1) onto the rear of the right side camshafts (2)

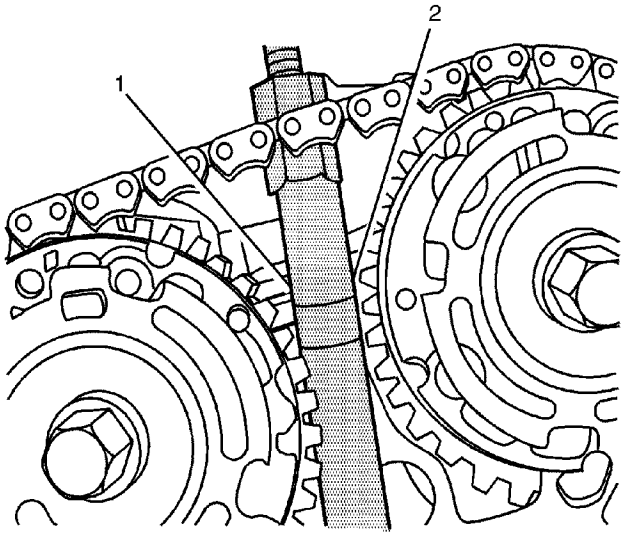
Caution: Refer to Torque Reaction Against Timing Drive Chain Caution in the Preface section.



Note:

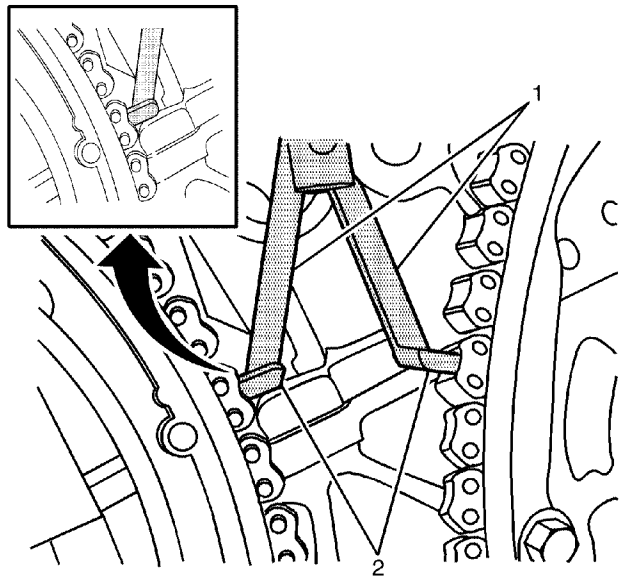
- Use an open-end wrench at the camshaft hex to prevent camshaft/engine rotation.
- DO NOT remove the camshaft position actuator to camshaft retaining bolt at this time.

9. Loosen the right side exhaust camshaft position actuator to camshaft retaining bolt.



Note: The front engine cover is removed in the following graphics for illustration purposes and is not required to perform the procedure.

10. Loosen the EN-48313 so that the legs are retracted.
11. Insert the EN-48313 between the camshaft actuators, rearward of the timing chain until the top line that is scribed in the body of the tool (1) is adjacent to the top surface of the cylinder head (2). This is the approximate installed position.



12. Make sure that the feet (2) on the legs (1) of the EN-48313 are facing the front of the engine.

Note: DO NOT tighten EN-48313 at this stage.

13. Partially expand the legs (1) of the EN-48313 by turning the T-shaped handle clockwise.

    Note: Make sure that the feet (2) of the EN-48313 are correctly engaged into one of the link pockets to prevent chain slipping during tightening.

14. Continue expanding the EN-48313 until the feet (2) contact the timing chain.

    Caution: Refer to Torque Reaction Against Timing Drive Chain Caution in the Preface section.

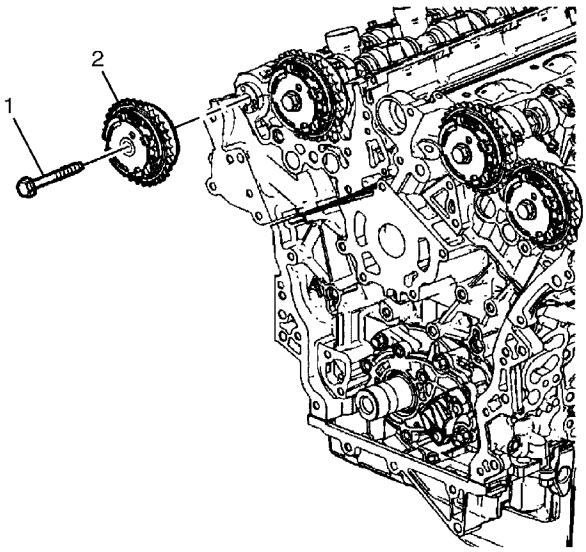
15. Hand tighten the EN-48313 .

    Note: DO NOT allow the body of the EN-48313 to rotate when tightening the T-handle.

16. Use an open-end wench on the hex cast into the body of the EN-48313 and hand tighten the T-handle.
17. Use an open-end wrench on the hex cast into the right intake and exhaust camshafts and rotate the camshafts towards each other in order create slack in the chain between the actuators.
18. The EN-48313 is now correctly installed to hold the timing chain in position.

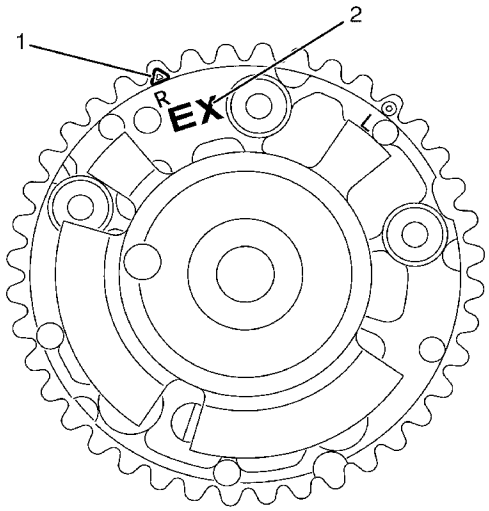
    Note: Make sure that the camshaft timing chain and the camshaft position actuators are marked for correct assembly.

19. Mark the timing chain and the camshaft position actuators.

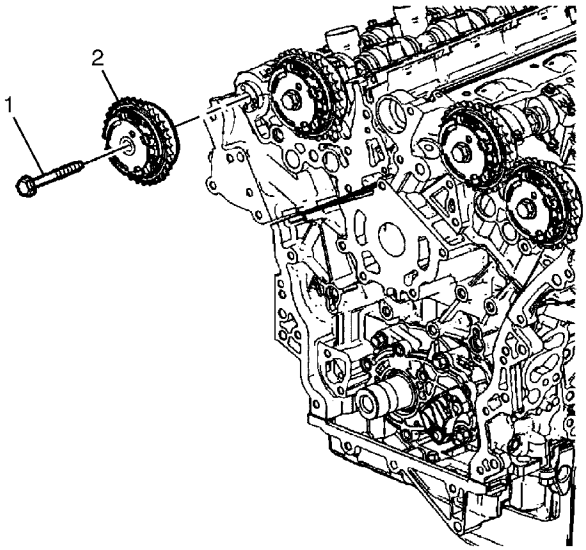


20. Remove the right side exhaust camshaft position actuator to camshaft retaining bolt (1).
21. Remove the right side exhaust camshaft position actuator (2).

Installation Procedure



1. Make sure the correct camshaft position actuator is installed. Observe the body of the camshaft position actuator for the "EX" marking (1). The marking is for an exhaust camshaft position actuator.
2. Make sure the correct timing mark is used. Observe the outer ring of the camshaft position actuator for the "R" and triangle marking (2). The marking is for alignment to the highlighted timing chain link on the right side of the engine.



3. Install the right side exhaust camshaft position actuator (2).

Note:

- Make sure that the marks on the camshaft position actuators and the timing chain are aligned.
- DO NOT tighten the right intake camshaft position actuator to camshaft retaining bolt (1) at this time.

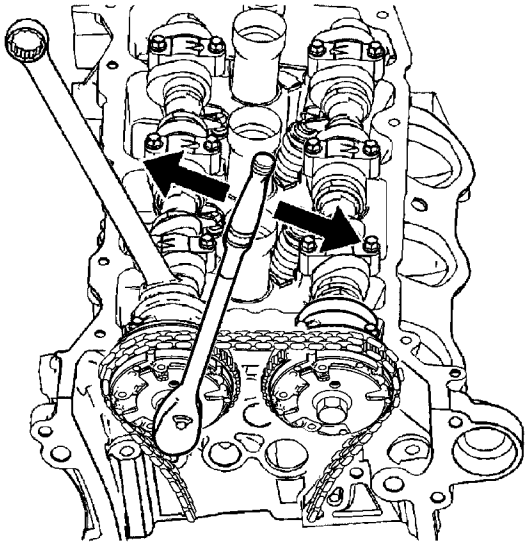
4. Install the right side camshaft position actuator to camshaft retaining bolt (1).

   DO NOT fully tighten at this stage.

5. Remove EN-48313 .

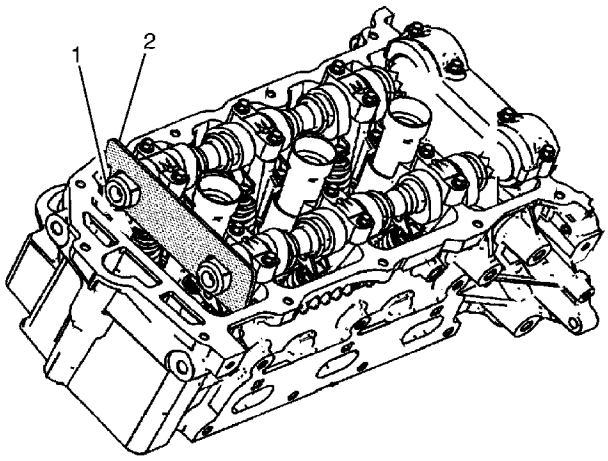
   Caution: Refer to Torque Reaction Against Timing Drive Chain Caution in the Preface section.

   Caution: Refer to Fastener Caution in the Preface section.



Note: Use an open-end wrench at the camshaft hex to prevent camshaft/engine rotation.

6. Install the camshaft position actuator using the camshaft retaining bolt and tighten to **58 N·m (43 lb ft)**.



7. Remove the EN 46105 (2) from the rear of the right side camshafts (1)
8. Install the camshaft position (CMP) actuator solenoids. Refer to (if fitted) Camshaft Position Actuator Replacement - Bank 1 (Right Side) Exhaust and Camshaft Position Actuator Replacement - Bank 1 (Right Side) Intake.
9. Install the camshaft position sensors. Refer to Camshaft Position Sensor Replacement - Bank 1 (Right Side) Exhaust and Camshaft Position Sensor Replacement - Bank 1 (Right Side) Intake.
10. Install the crankshaft balancer. Refer to Crankshaft Balancer Installation.
11. Install the right side camshaft cover. Refer to Camshaft Cover Replacement - Right Side.
12. Install the upper intake manifold with the lower intake manifold. Refer to Lower Intake Manifold Replacement.
13. Install the engine covers. Refer to Engine Cover Replacement.

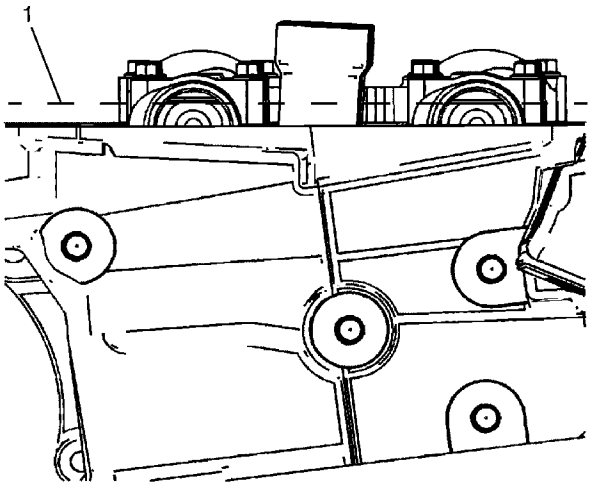
Camshaft Position Actuator Replacement - Bank 2 (Left Side) Intake

Tools Required

- EN 46105 Camshaft Locking Tools
- EN-48313 Timing Chain Retention Tool
- EN 46111 Crankshaft Rotation Socket

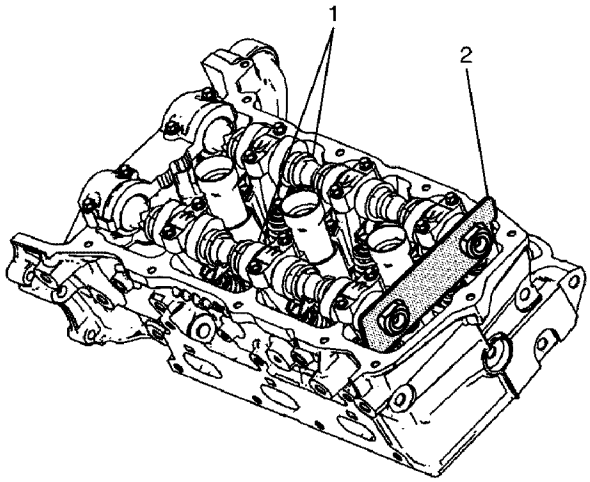
Removal Procedure

1. Remove the engine covers. Refer to Engine Cover Replacement.
2. Remove the upper intake manifold with the lower intake manifold. Refer to Lower Intake Manifold Replacement.
3. Remove the left side camshaft cover. Refer to Camshaft Cover Replacement - Left Side.
4. Remove the camshaft position sensors. Refer to (if fitted) Camshaft Position Sensor Replacement - Bank 2 (Left Side) Exhaust and Camshaft Position Sensor Replacement - Bank 2 (Left Side) Intake.
5. Remove the camshaft position (CMP) actuator solenoids. Refer to (if fitted) Camshaft Position Actuator Solenoid Valve Solenoid Replacement - Bank 2 (Left Side) Exhaust and Camshaft Position Actuator Solenoid Valve Solenoid Replacement - Bank 2 (Left Side) Intake.
6. Remove the crankshaft balancer. Refer to Crankshaft Balancer Removal.



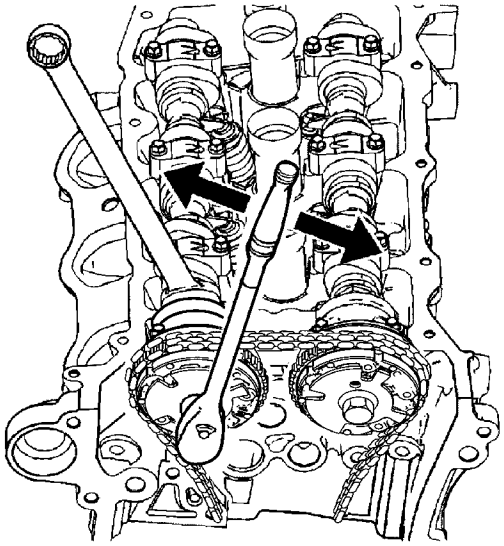
7. Rotate the crankshaft with the EN 46111 until the camshafts are in a neutral (low tension) position. The camshaft flats will be parallel with the camshaft cover rail (1).

© 2010 General Motors Corporation. All rights reserved.



8. Install the EN 46105 (2) onto the rear of the left side camshafts (1).

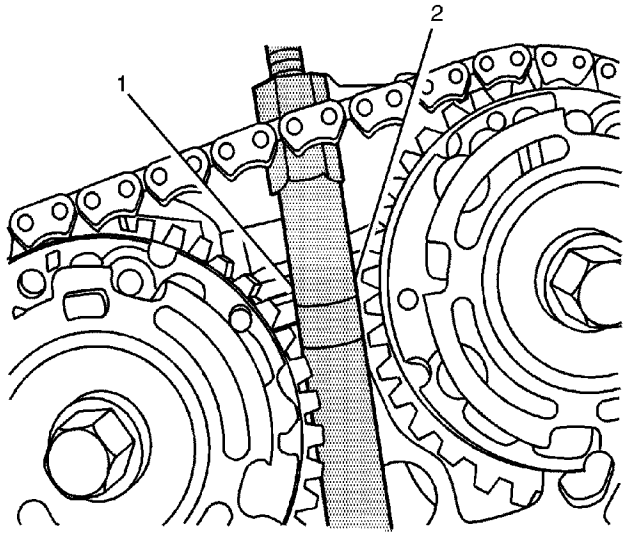
Caution: Refer to Torque Reaction Against Timing Drive Chain Caution in the Preface section.



Note:

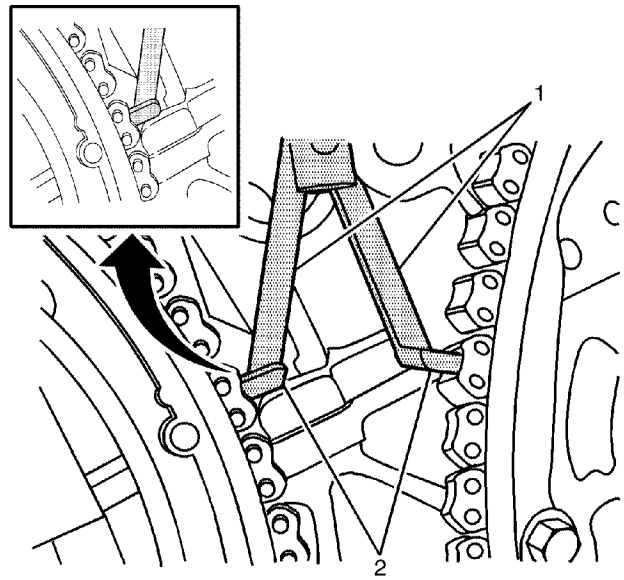
- Use an open-end wrench at the camshaft hex to prevent camshaft/engine rotation.
- DO NOT remove the camshaft position actuator to camshaft retaining bolt at this time.

9. Loosen the left side intake camshaft position actuator to camshaft retaining bolt.



Note: The front engine cover is removed in the following graphics for illustration purposes and is not required to perform the procedure.

10. Insert the EN-48313 between the camshaft actuators, rearward of the timing chain until the top line that is scribed in the body of the tool (1) is adjacent to the top surface of the cylinder head (2). This is the approximate installed position.
11. Loosen the EN-48313 so that the legs are retracted.



12. Make sure that the feet (2) on the legs (1) of the EN-48313 are facing the front of the engine.

Note: DO NOT tighten EN-48313 at this stage.

13. Partially expand the legs (1) of the EN-48313 by turning the T-shaped handle clockwise.

    Note: Make sure that the feet (2) of the EN-48313 are correctly engaged into one of the link pockets to prevent chain slipping during tightening.

14. Continue expanding the EN-48313 until the feet (2) contact the timing chain.

    Caution: Refer to Torque Reaction Against Timing Drive Chain Caution in the Preface section.

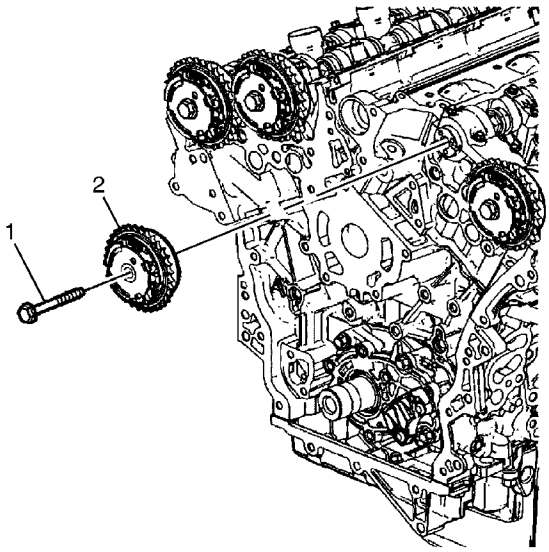
15. Hand tighten the EN-48313 .

    Note: DO NOT allow the body of the EN-48313 to rotate when tightening the T-handle.

16. Use an open-end wench on the hex cast into the body of the EN-48313 and hand tighten the T-handle.
17. Use an open-end wrench on the hex cast of the left side intake and exhaust camshafts and rotate the camshafts towards each other in order create slack in the chain between the actuators.
18. The EN-48313 is now correctly installed to hold the timing chain in position.

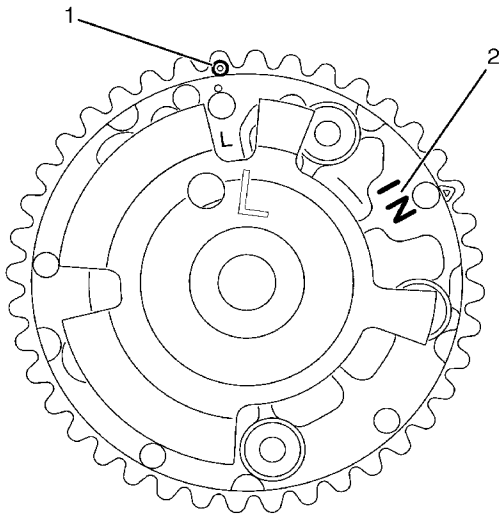
    Note: Make sure that the camshaft timing chain and the camshaft position actuators are marked for correct assembly.

19. Mark the timing chain and the camshaft position actuators.

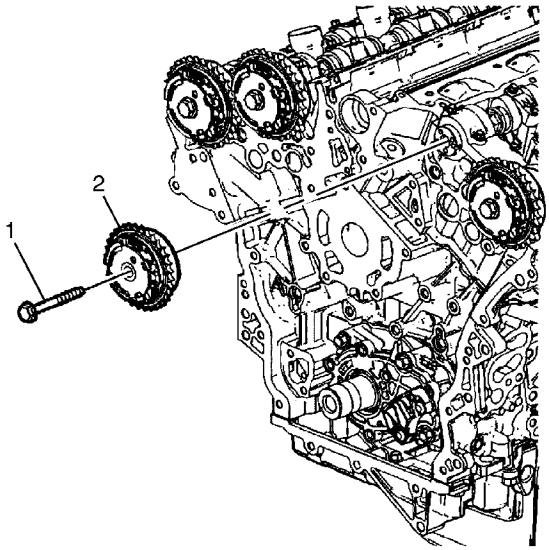


20. Remove the left side intake camshaft position actuator to camshaft retaining bolt (1).
21. Remove the left side intake camshaft position actuator (2).

Installation Procedure



1. Make sure the correct camshaft position actuator is installed. Observe the body of the camshaft position actuator for the "IN" marking (2). The marking is for an intake camshaft position actuator.
2. Make sure the correct timing mark is used. Observe the outer ring of the camshaft position actuator for the "L" and circle marking (1). The marking is for alignment to the highlighted timing chain link on the left side of the engine.



3. Install the left side intake camshaft position actuator (2).

Note:

- Make sure that the marks on the camshaft position actuators and the timing chain are aligned.
- DO NOT tighten the right intake camshaft position actuator to camshaft retaining bolt (1) at this time.

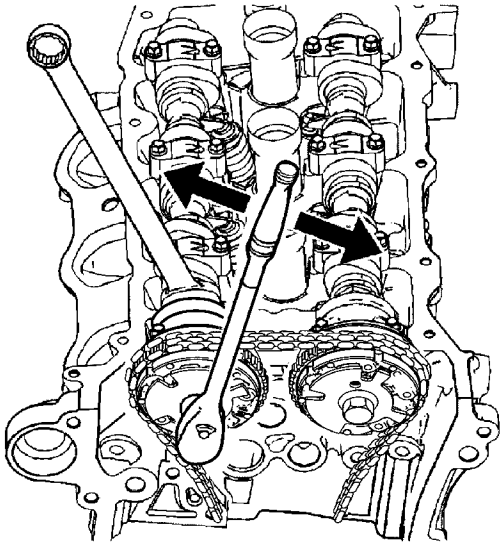
4. Install the camshaft position actuator to camshaft retaining bolt (1).

   DO NOT fully tighten at this stage.

5. Remove EN-48313 .

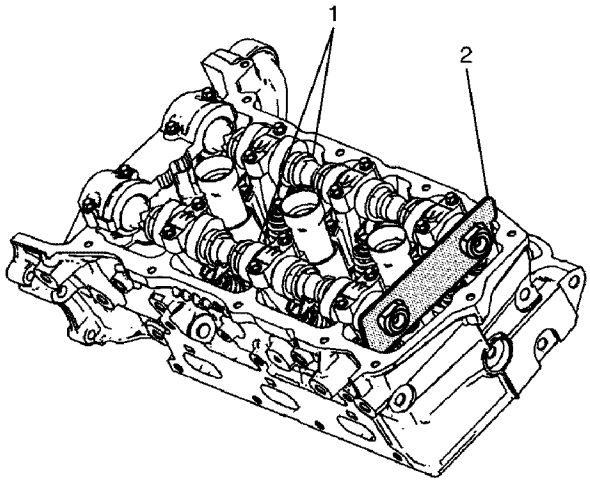
   Caution: Refer to Torque Reaction Against Timing Drive Chain Caution in the Preface section.

   Caution: Refer to Fastener Caution in the Preface section.



Note: Use an open-end wrench at the camshaft hex to prevent camshaft/engine rotation.

6. Install the camshaft position actuator using the camshaft retaining bolt and tighten to **58 N·m (43 lb ft)**.



7. Remove the EN 46105 (2) from the rear of the left side camshafts (1)
8. Install the camshaft position (CMP) actuator solenoids. Refer to (if fitted) Camshaft Position Actuator Solenoid Valve Solenoid Replacement - Bank 2 (Left Side) Exhaustand Camshaft Position Actuator Solenoid Valve Solenoid Replacement - Bank 2 (Left Side) Intake.
9. Install the camshaft position sensors. Refer to (if fitted) Camshaft Position Sensor Replacement - Bank 2 (Left Side) Exhaust and Camshaft Position Sensor Replacement - Bank 2 (Left Side) Intake.
10. Install the crankshaft balancer. Refer to Crankshaft Balancer Installation.
11. Install the left bank camshaft cover. Refer to Camshaft Cover Replacement - Left Side.
12. Install the upper intake manifold with the lower intake manifold. Refer to Lower Intake Manifold Replacement.
13. Install the engine covers. Refer to Engine Cover Replacement.

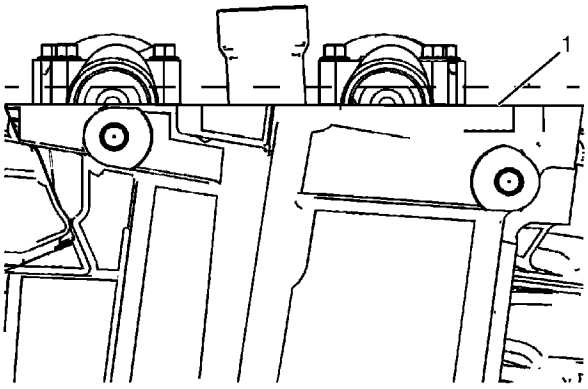
Camshaft Position Actuator Replacement - Bank 1 (Right Side) Intake

Tools Required

- EN 46105 Camshaft Locking Tools
- EN-48313 Timing Chain Retention Tool
- EN 46111 Crankshaft Rotation Socket

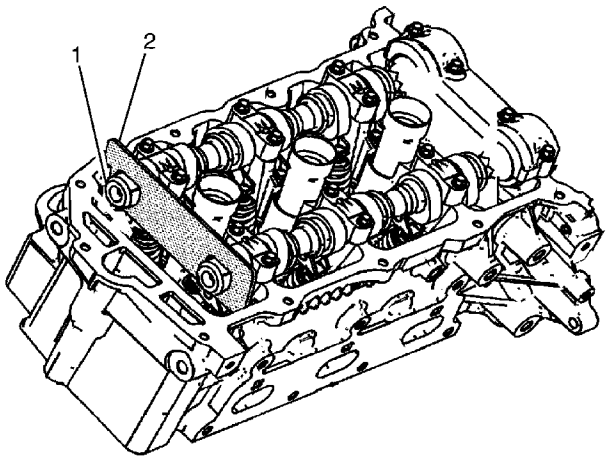
Removal Procedure

1. Remove the engine covers. Refer to Engine Cover Replacement.
2. Remove the upper intake manifold with the lower intake manifold. Refer to Lower Intake Manifold Replacement.
3. Remove the right side camshaft cover. Refer to Camshaft Cover Replacement - Right Side.
4. Remove the camshaft position sensors. Refer to Camshaft Position Sensor Replacement - Bank 1 (Right Side) Exhaust and Camshaft Position Sensor Replacement - Bank 1 (Right Side) Intake.
5. Remove the camshaft position (CMP) actuator solenoids. Refer to (if fitted) Camshaft Position Actuator Solenoid Valve Solenoid Replacement - Bank 1 (Right Side) Exhaust and Camshaft Position Actuator Solenoid Valve Solenoid Replacement - Bank 1 (Right Side) Intake.
6. Remove the crankshaft balancer. Refer to Crankshaft Balancer Removal.



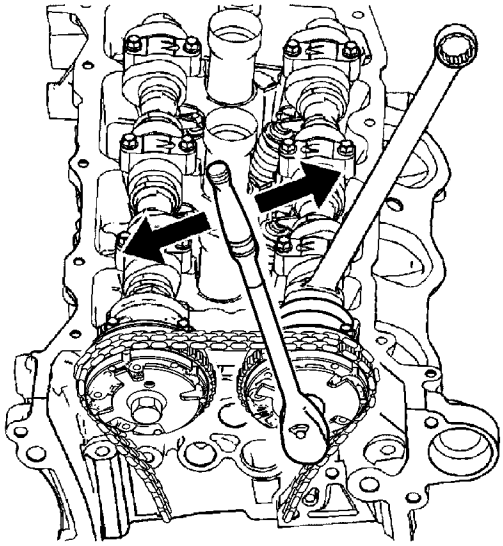
7. Rotate the crankshaft with the EN 46111 until the camshafts are in a neutral (low tension) position. The camshaft flats will be parallel with the camshaft cover rail (1).

© 2010 General Motors Corporation. All rights reserved.



8. Install the EN 46105 (2) onto the rear of the right side camshafts (1)

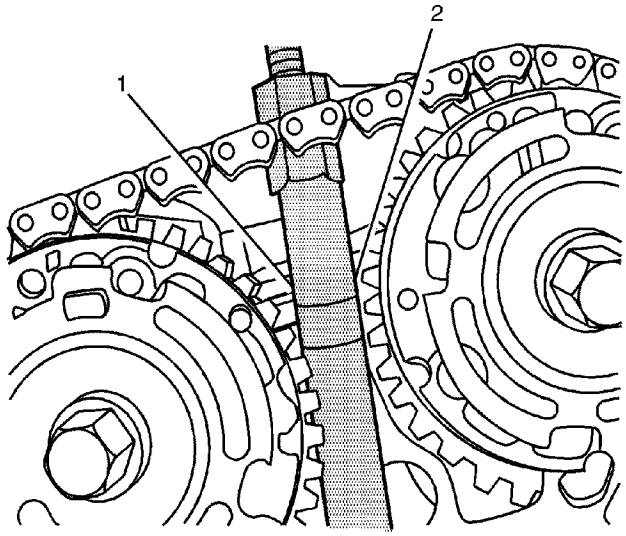
Caution: Refer to Torque Reaction Against Timing Drive Chain Caution in the Preface section.



Note:

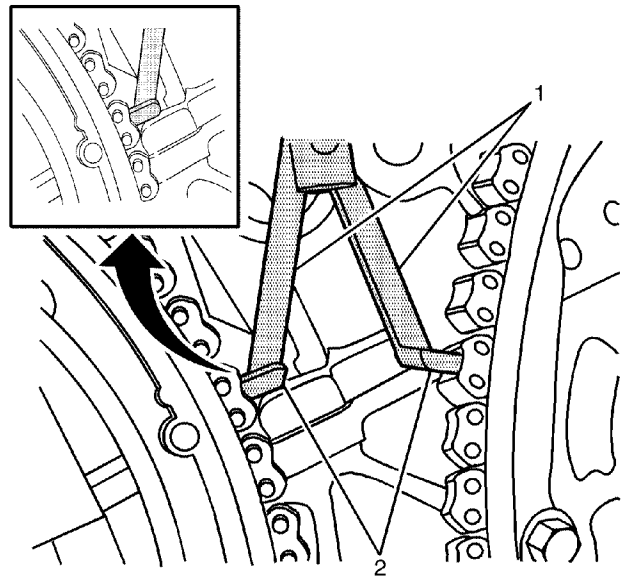
- Use an open-end wrench at the camshaft hex to prevent camshaft/engine rotation.
- DO NOT remove the camshaft position actuator to camshaft retaining bolt at this time.

9. Loosen the right side intake camshaft position actuator to camshaft retaining bolt.
10. Loosen the EN-48313 so that the legs are retracted.



Note: The front engine cover is removed in the following graphics for illustration purposes and is not required to perform the procedure.

11. Insert the EN-48313 between the camshaft actuators, rearward of the timing chain until the top line that is scribed in the body of the tool (1) is adjacent to the top surface of the cylinder head (2). This is the approximate installed position.



12. Make sure that the feet (2) on the legs (1) of the EN-48313 are facing the front of the engine.

Note: DO NOT tighten EN-48313 at this stage.

13. Partially expand the legs (1) of the EN-48313 by turning the T-shaped handle clockwise.

Note: Make sure that the feet (2) of the EN-48313 is correctly engaged into one of the link pockets to prevent chain slipping during tightening.

14. Continue expanding the EN-48313 until the feet (2) contact the timing chain.

Caution: Refer to Torque Reaction Against Timing Drive Chain Caution in the Preface section.

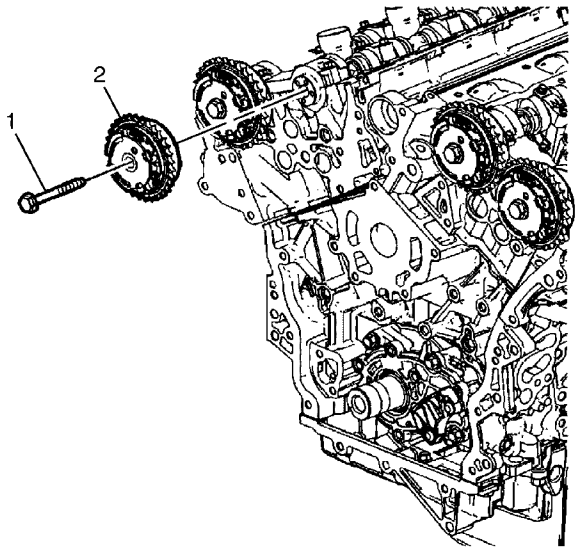
15. Hand tighten the EN-48313 .

Note: DO NOT allow the body of the tool to rotate when tightening the T-handle.

16. Use an open-end wench on the hex cast into the body of the EN-48313 and hand tighten the T-handle.
17. Use an open-end wrench on the hex cast into the right intake and exhaust camshafts and rotate the camshafts towards each other in order create slack in the chain between the actuators.
18. The EN-48313 is now correctly installed to hold the timing chain in position.

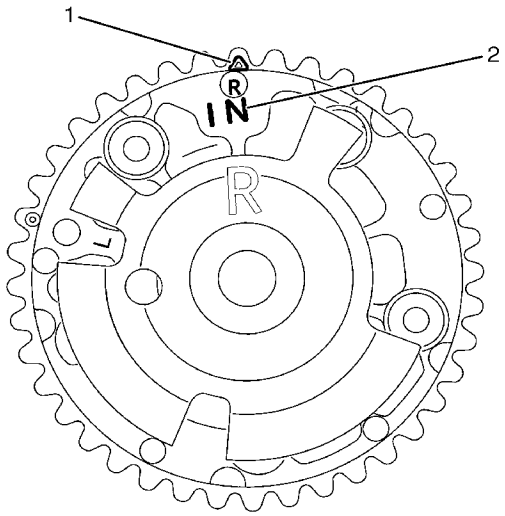
Note: Make sure that the camshaft timing chain and the camshaft position actuators are marked for correct assembly.

19. Mark the timing chain and the camshaft position actuators.

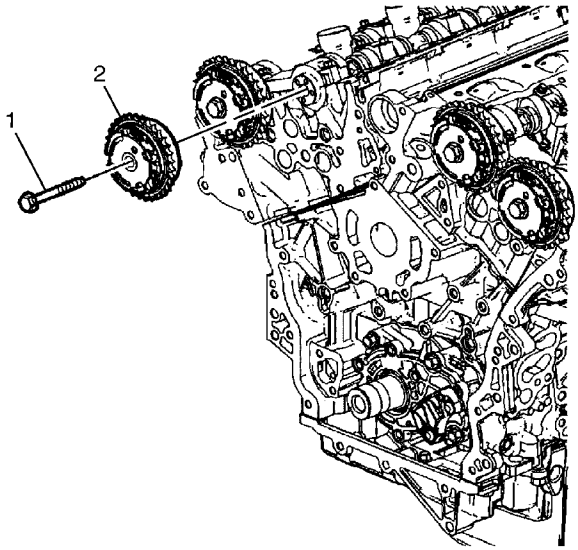


20. Remove the right side intake camshaft position actuator to camshaft retaining bolt (1).
21. Remove the right side intake camshaft position actuator (2).

Installation Procedure



1. Make sure the correct camshaft position actuator is installed. Observe the body of the camshaft position actuator for the "IN" marking (2). The marking is for an intake camshaft position actuator.
2. Make sure the correct timing mark is used. Observe the outer ring of the camshaft position actuator for the "R" and triangle marking (1). The marking is for alignment to the highlighted timing chain link on the right side of the engine.



3. Install the right side intake camshaft position actuator (2).

Note:

- Make sure that the marks on the camshaft position actuators and the timing chain are aligned.
- DO NOT tighten the right intake camshaft position actuator to camshaft retaining bolt (1) at this time.

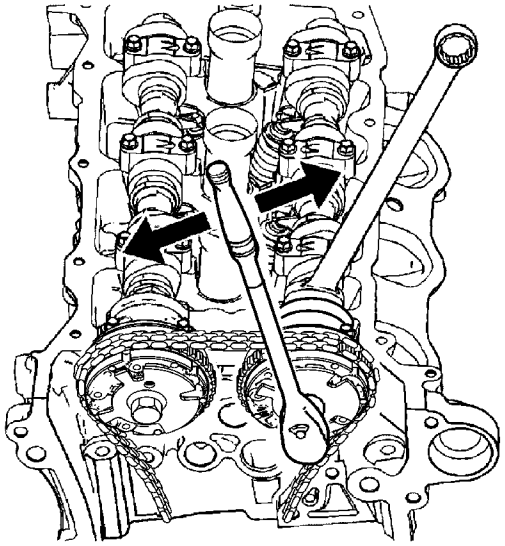
4. Install the right side intake camshaft position actuator to camshaft retaining bolt (1).

   DO NOT fully tighten at this stage.

5. Remove the EN 46108 EN 48313.

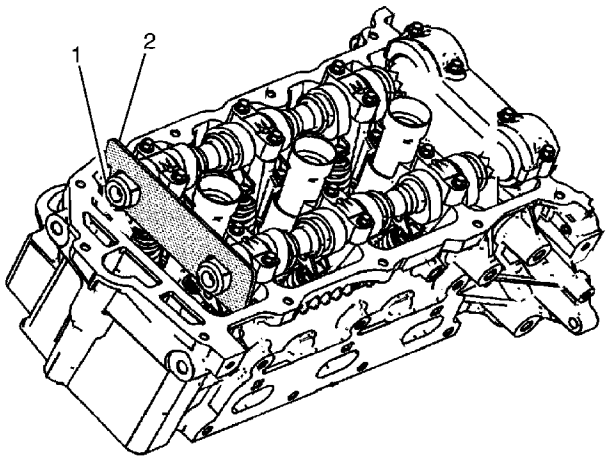
   Caution: Refer to Torque Reaction Against Timing Drive Chain Caution in the Preface section.

   Caution: Refer to Fastener Caution in the Preface section.



Note: Use an open-end wrench at the camshaft hex to prevent camshaft/engine rotation.

6. Install the camshaft position actuator using the camshaft retaining bolt and tighten to **58 N·m (43 lb ft)**.



7. Remove the EN 46105 (2) from the rear of the right side camshafts (1)
8. Install the camshaft position (CMP) actuator solenoids. Refer to (if fitted) Camshaft Position Actuator Solenoid Valve Solenoid Replacement - Bank 1 (Right Side) Exhaust and Camshaft Position Actuator Solenoid Valve Solenoid Replacement - Bank 1 (Right Side) Intake.
9. Install the camshaft position sensors. Refer to Camshaft Position Sensor Replacement - Bank 1 (Right Side) Exhaust and Camshaft Position Sensor Replacement - Bank 1 (Right Side) Intake.
10. Install the crankshaft balancer. Refer to Crankshaft Balancer Installation.
11. Install the right side camshaft cover. Refer to Camshaft Cover Replacement - Right Side.
12. Install the upper intake manifold with the lower intake manifold. Refer to Lower Intake Manifold Replacement.
13. Install the engine covers. Refer to Engine Cover Replacement.

Setting Camshaft Timing

Important: Setting the camshaft timing is necessary whenever the camshaft drive system has been disturbed such that the relationship between any chain and sprocket has been lost. Even when only one sprocket is involved, multiple crankshaft rotations will not produce conditions where correct timing can be confirmed.

If necessary, follow the left bank secondary camshaft drive chain replacement procedures to reset the camshaft timing. Refer to Secondary Camshaft Drive Chain Replacement - Left Side .

© 2010 General Motors Corporation. All rights reserved.

Camshaft Replacement - Left Side

Removal Procedure

1. Remove the left side camshaft position actuators. Refer to Camshaft Position Actuator Replacement - Bank 2 (Left Side) Exhaust and Camshaft Position Actuator Replacement - Bank 2 (Left Side) Intake.
2. Remove the left side camshafts. Refer to Camshaft Removal - Left Side.

Installation Procedure

1. Install the left side camshafts. Refer to Camshaft Removal - Left Side.
2. Install the left side camshaft position actuators. Refer to Camshaft Position Actuator Replacement - Bank 2 (Left Side) Exhaust and Camshaft Position Actuator Replacement - Bank 2 (Left Side) Intake.

© 2010 General Motors Corporation. All rights reserved.

Camshaft Replacement - Right Side

Removal Procedure

1. Remove the right side camshaft position actuators. Refer to Camshaft Position Actuator Replacement - Bank 1 (Right Side) Exhaust and Camshaft Position Actuator Replacement - Bank 1 (Right Side) Intake.
2. Remove the right side camshafts. Refer to Camshaft Removal - Right Side.

Installation Procedure

1. Install the right side camshafts. Refer to Camshaft Installation - Right Side.
2. Install the right side camshaft position actuators. Refer to Camshaft Position Actuator Replacement - Bank 1 (Right Side) Exhaust and Camshaft Position Actuator Replacement - Bank 1 (Right Side) Intake.

© 2010 General Motors Corporation. All rights reserved.

Valve Rocker Arm Replacement - Left Side

Removal Procedure

1. Remove the applicable camshaft(s). Refer to Camshaft Replacement - Left Side.
2. Remove the rocker arms. Refer to Valve Rocker Arm Removal - Left Side.
3. Clean and inspect the camshaft(s) and the rocker arm(s). Repair or replace as necessary. Refer to Camshaft Cleaning and Inspection and Valve Lifters Cleaning and Inspection.

Installation Procedure

1. Install the rocker arms. Refer to Valve Rocker Arm Installation - Left Side.
2. Install the applicable camshaft(s). Refer to Camshaft Replacement - Left Side.

© 2010 General Motors Corporation. All rights reserved.

Valve Rocker Arm Replacement - Right Side

Removal Procedure

1. Remove the applicable camshaft(s). Refer to Camshaft Replacement - Right Side.
2. Remove the rocker arms. Refer to Valve Rocker Arm Removal - Right Side.
3. Clean and inspect the camshaft(s) and the rocker arm(s). Repair or replace as necessary. Refer to Camshaft Cleaning and Inspection and Valve Lifters Cleaning and Inspection.

Installation Procedure

1. Install the rocker arms. Refer to Valve Rocker Arm Installation - Right Side.
2. Install the applicable camshaft(s). Refer to Camshaft Installation - Right Side.

© 2010 General Motors Corporation. All rights reserved.

Valve Lifter Replacement - Left Side

Removal Procedure

1. Remove the applicable camshaft(s). Camshaft Replacement - Left Side.
2. Remove the rocker arms. Refer to Valve Rocker Arm Removal - Left Side.
3. Remove the lifters. Refer to Valve Lifter Removal - Left Side.
4. Clean and inspect the camshaft(s), rocker arm(s) and lifter(s). Repair or replace as necessary. Refer to Camshaft Cleaning and Inspection and Valve Rocker Arm Cleaning and Inspection and Valve Lifters Cleaning and Inspection.

Installation Procedure

1. Install the lifters. Refer to Valve Lifter Installation - Left Side.
2. Install the rocker arms. Refer to Valve Rocker Arm Installation - Left Side.
3. Install the applicable camshaft(s). Refer to Camshaft Replacement - Left Side.

© 2010 General Motors Corporation. All rights reserved.

Valve Lifter Replacement - Right Side

Removal Procedure

1. Remove the applicable camshaft(s). Refer to Camshaft Replacement - Right Side.
2. Remove the rocker arms. Refer to Valve Rocker Arm Removal - Right Side.
3. Remove the lifters. Refer to Valve Lifter Removal - Right Side.
4. Clean and inspect the camshaft(s), rocker arm(s) and lifter(s). Repair or replace as necessary. Refer to Camshaft Cleaning and Inspection and Valve Rocker Arm Cleaning and Inspection and Valve Lifters Cleaning and Inspection.

Installation Procedure

1. Install the lifters. Refer to Valve Lifter Installation - Right Side.
2. Install the rocker arms. Refer to Valve Rocker Arm Installation - Right Side.
3. Install the applicable camshaft(s). Refer to Camshaft Installation - Right Side.

© 2010 General Motors Corporation. All rights reserved.

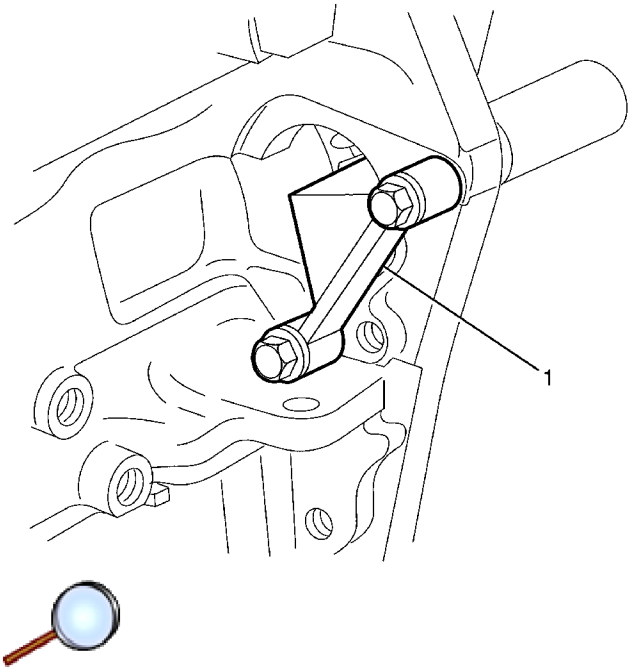
Valve Stem Oil Seal and Valve Spring Replacement - Left Side

Tools Required

- EN 46106 Flywheel Holding Tool
- EN 46110 On-Vehicle Valve Spring Compressor
- EN 46116 Valve Stem Seal Remover/Installer
- J 39313 Spark Plug Port Adapter
- EN 46117 Valve Collet Remover/Installer

Removal Procedure

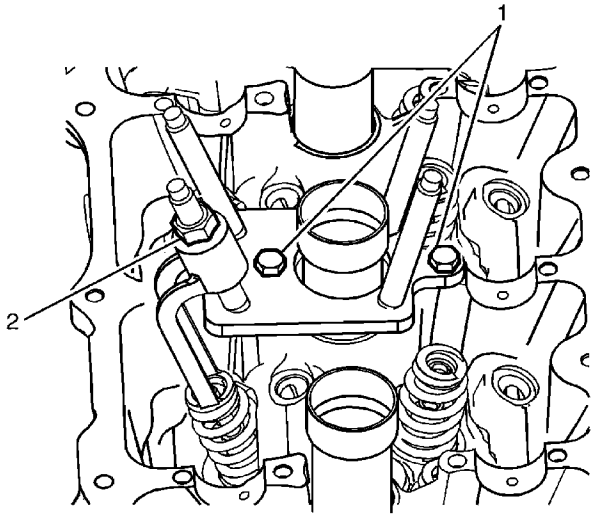
1. Remove the starter motor. Refer to Starter Motor Replacement.



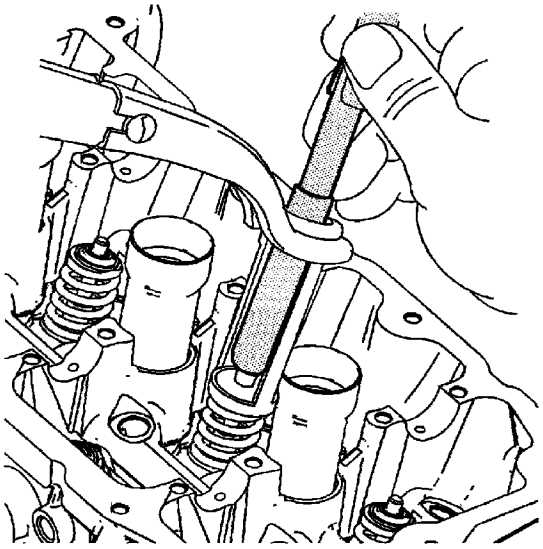
Important: If the EN 46106 (1) is not installed, the crankshaft may rotate. If the crankshaft rotates, disassembly and reassembly of the entire camshaft timing system may be required.

2. Install the EN 46106 (1) in order to prevent crankshaft rotation.
3. Remove the camshafts and rocker arms. Refer to Camshaft Replacement - Left Side.
4. Remove the spark plug from the applicable cylinder. Refer to Spark Plug Replacement.
5. Install the J 39313 to the applicable cylinder.
6. Connect the J 39313 to a compressed air source.
7. Install the EN 46110 above the applicable cylinder.

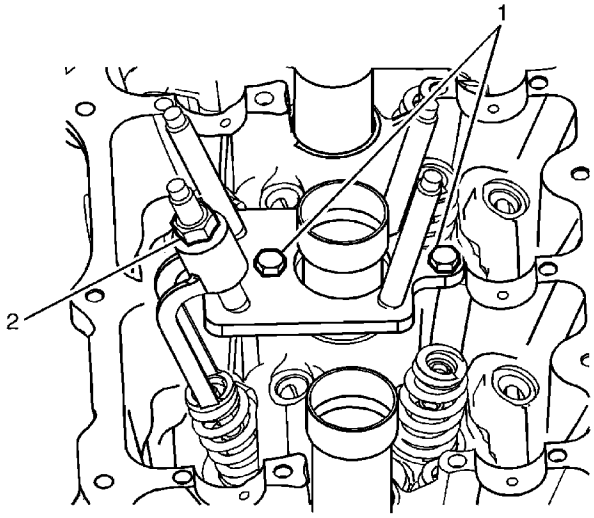
© 2010 General Motors Corporation. All rights reserved.



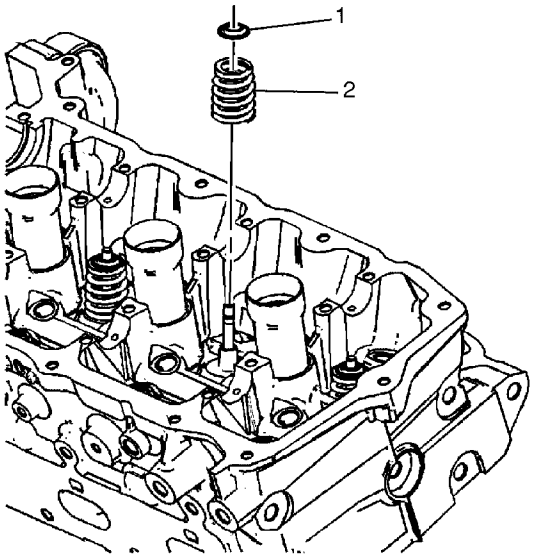
8. Install the EN 46110 to cylinder head retaining bolts (1)
9. Tighten the EN 46110 valve spring compressor nut (2).



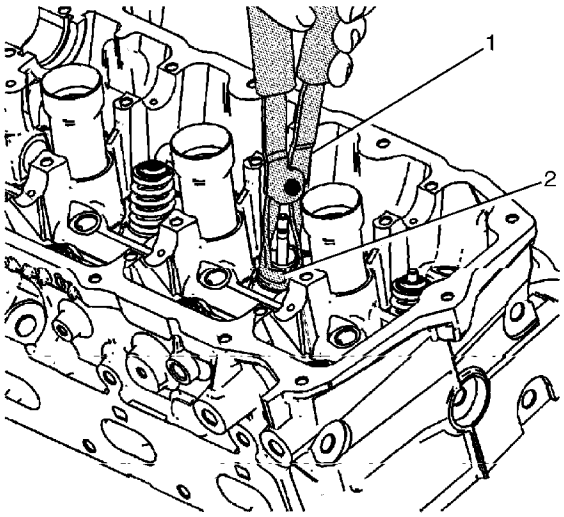
10. Remove the valve collets using the EN 46117 .



11. Loosen the EN 46110 valve spring compressor nut (2).
12. Remove the EN 46110 to cylinder head retaining bolts (1).
13. Remove the EN 46110 .



14. Remove the valve spring retainer (1).
15. Remove the valve spring (2).



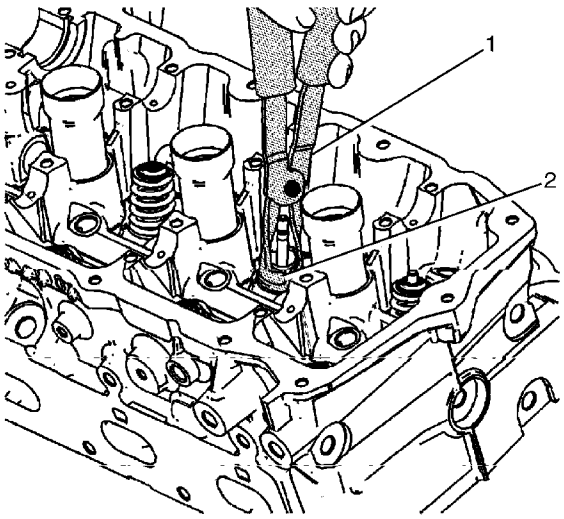
Important: NEVER reuse a valve stem oil seal.

16. Remove the valve stem oil seal (2) using the EN 46116 (1).

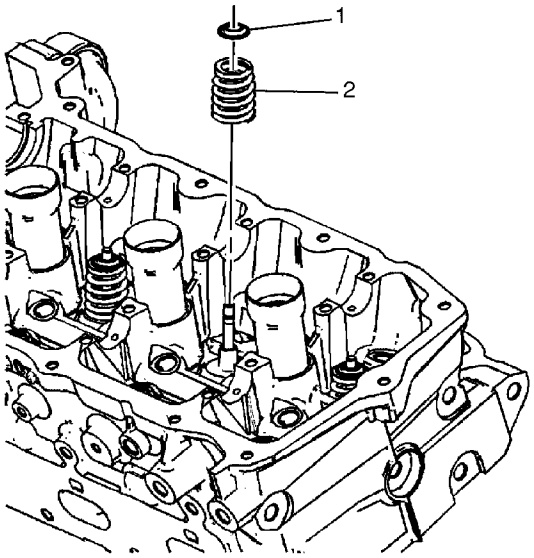
    Discard the valve stem oil seals.

17. Repeat these procedures for the remaining valves.

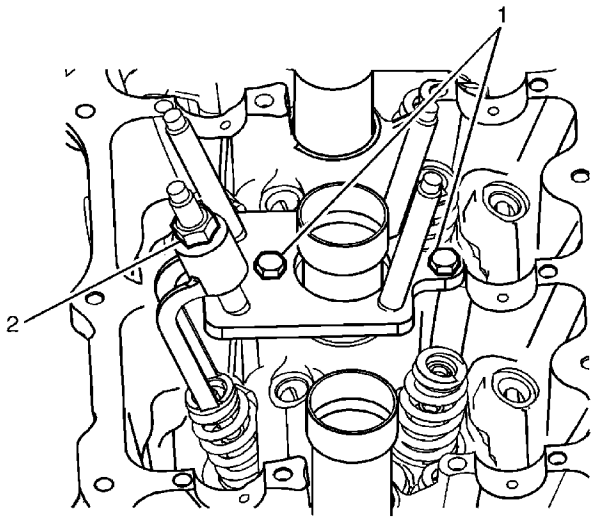
Installation Procedure



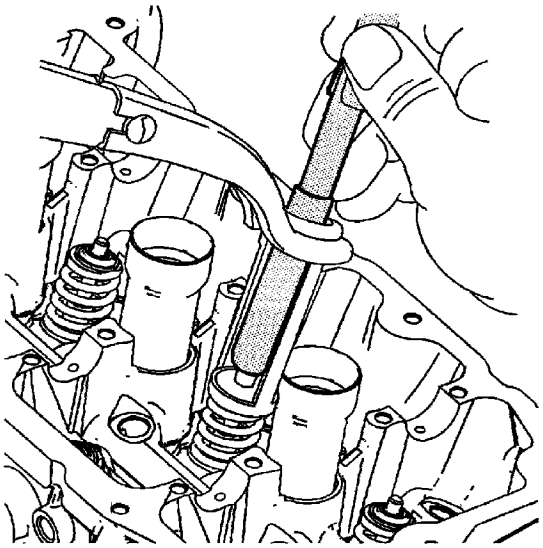
1. Use the EN 46116 (1) in order to install the NEW valve stem seal (2).



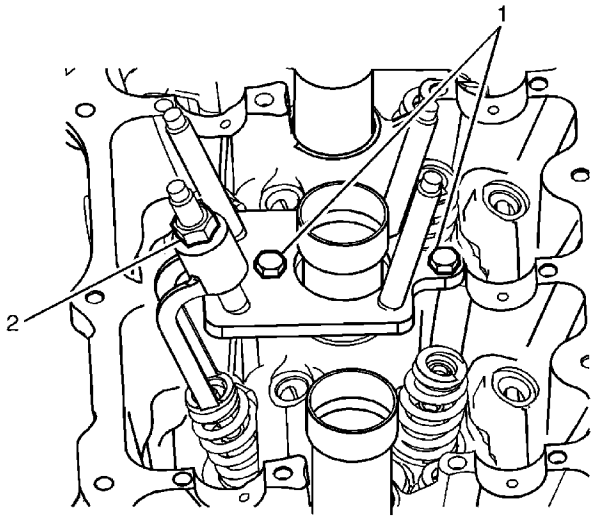
2. Install the valve spring (2).
3. Install the valve spring retainer (1).



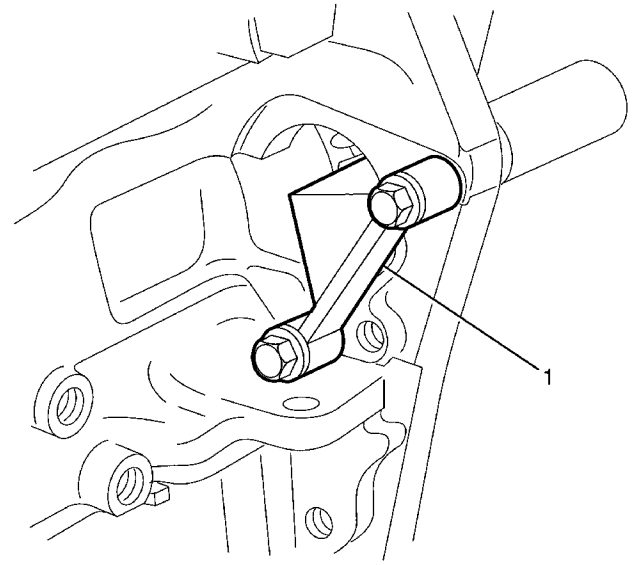
4. Install the EN 46110 above the applicable valve spring.
5. Install the EN 46110 to cylinder head retaining bolts (1)
6. Tighten the EN 46110 valve spring compressor nut (2).



7. Install the valve collets using the EN 46117 (1).



8. Loosen the EN 46110 valve spring compressor nut (2).
9. Remove the EN 46110 to cylinder head retaining bolts (1).
10. Remove the EN 46110
11. Disconnect the J 39313 from the compressed air source.
12. Remove the J 39313 .
13. Install the spark plugs. Refer to Spark Plug Replacement.
14. Install the rocker arms and camshafts. Refer to Camshaft Replacement - Left Side.



15. Remove the EN 46106 (1).
16. Install the starter motor. Refer to Starter Motor Replacement.

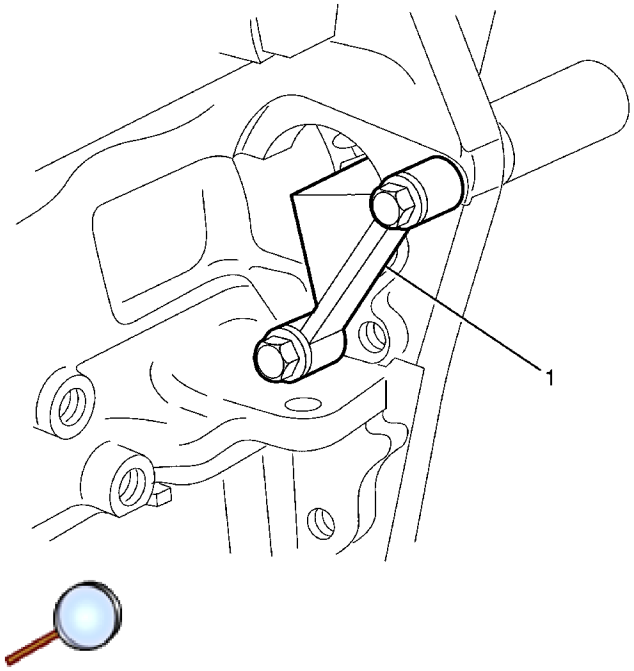
Valve Stem Oil Seal and Valve Spring Replacement - Right Side

Tools Required

- EN 46106 6 Flywheel Holding Tool
- EN 46110 On-Vehicle Valve Spring Compressor
- EN 46116 Valve Stem Seal Remover/Installer
- J 39313 Spark Plug Port Adapter
- EN 46117 Valve Collet Remover/Installer

Removal Procedure

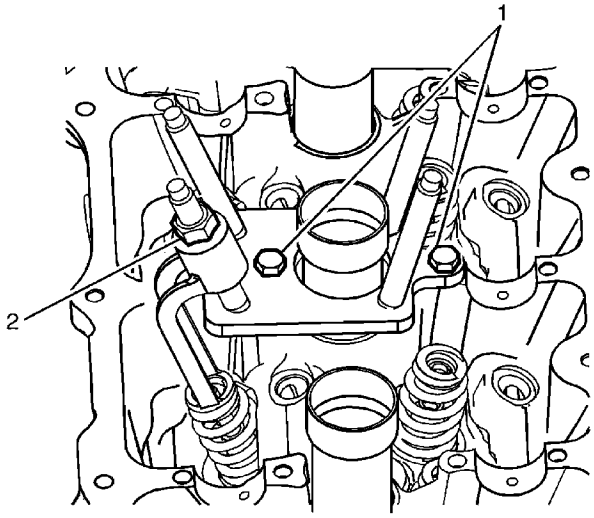
1. Remove the starter motor. Refer to Starter Motor Replacement.



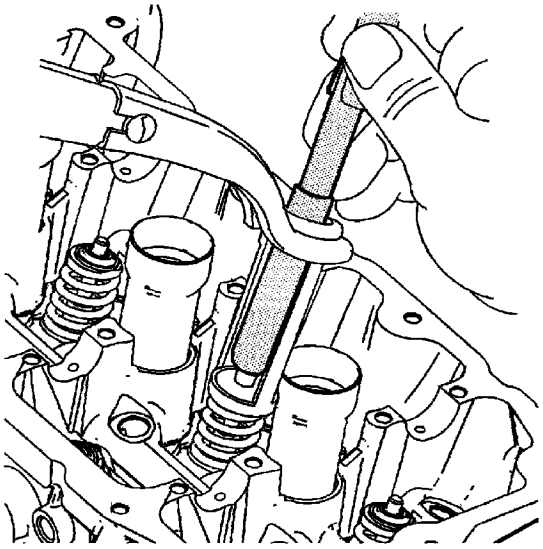
Important: If the EN 46106 is not installed, the crankshaft may rotate. If the crankshaft rotates, disassembly and reassembly of the entire camshaft timing system may be required.

2. Install the EN 46106 (1).
3. Remove the camshafts and rocker arms. Refer to Camshaft Replacement - Left Side.
4. Remove the spark plug from the applicable cylinder. Refer to Spark Plug Replacement.
5. Install the J 39313 to the applicable cylinder.
6. Connect the J 39313 to a compressed air source.
7. Install the EN 46110 above the applicable cylinder.

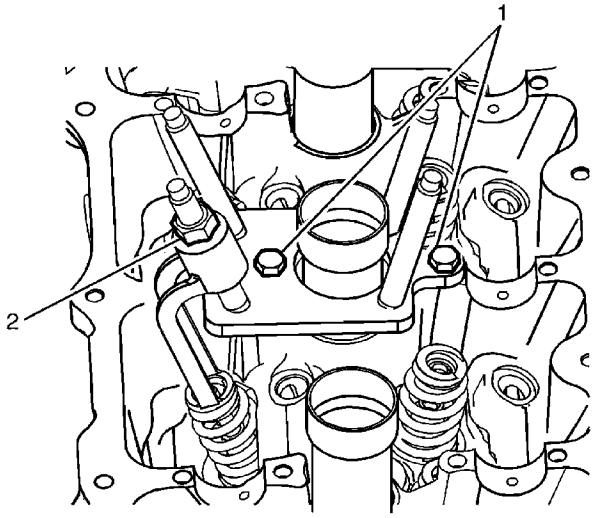
© 2010 General Motors Corporation. All rights reserved.



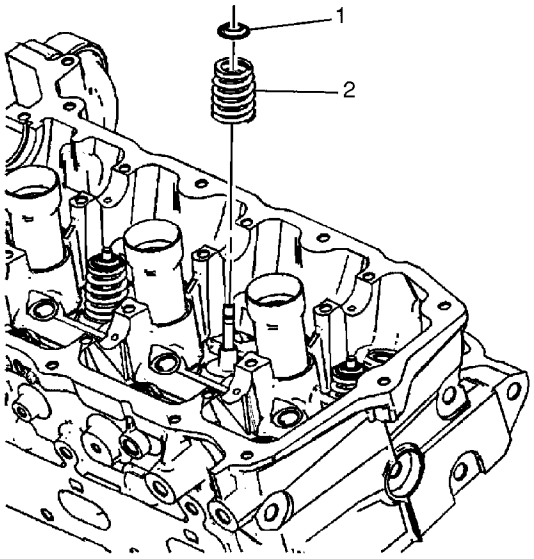
8. Install the EN 46110 to cylinder head retaining bolts (1)
9. Tighten the EN 46110 valve spring compressor nut (2).



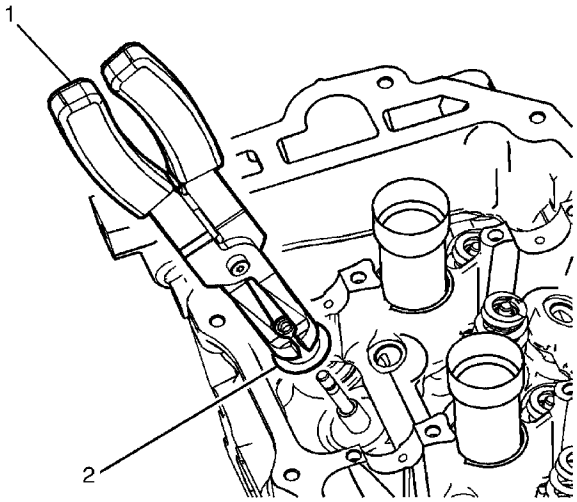
10. Remove the valve collets using the EN 46117 .



11. Loosen the EN 46110 valve spring compressor nut (2).
12. Remove the EN 46110 to cylinder head retaining bolts (1).
13. Remove the EN 46110 .

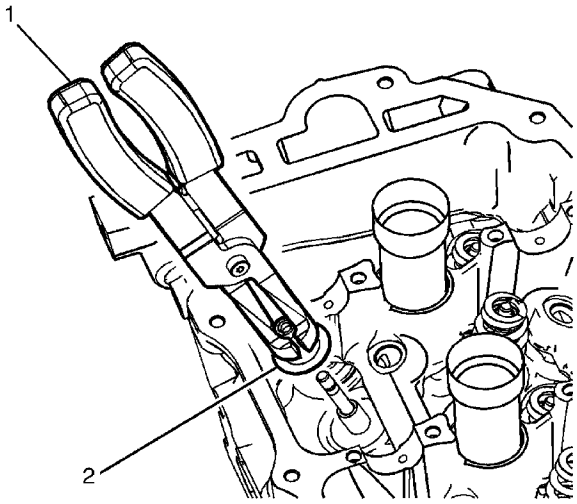


14. Remove the valve spring retainer (1).
15. Remove the valve spring (2).

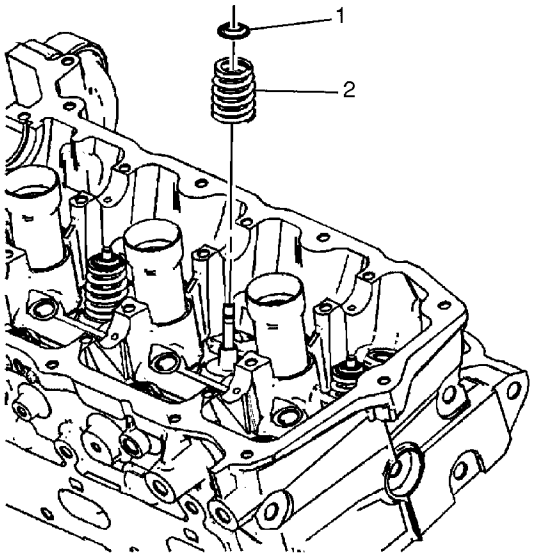


16. Use the EN 46116 (1) in order to remove the valve stem seal (2).

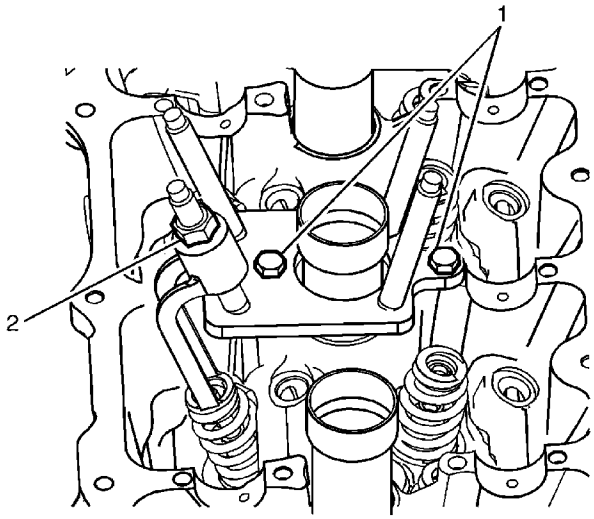
Installation Procedure



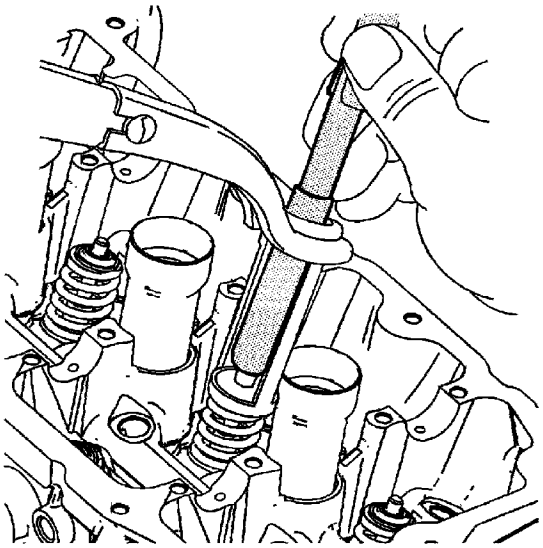
1. Use the EN 46116 (1) in order to install the valve stem seal (2).



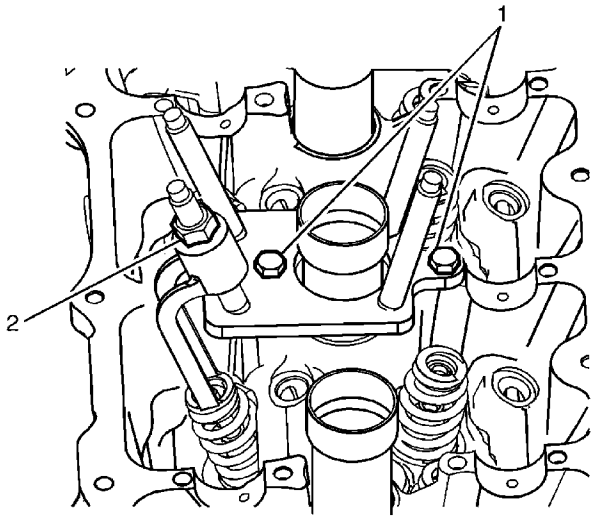
2. Install the valve spring (2).
3. Install the valve spring retainer (1).



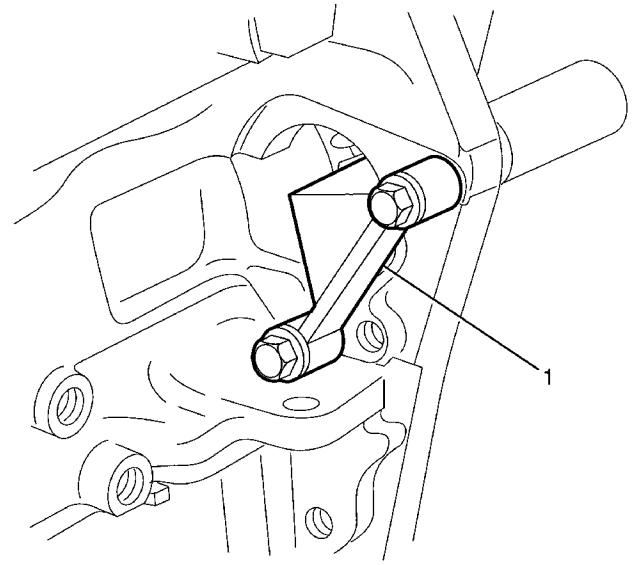
4. Install the EN 46110 above the applicable valve spring.
5. Install the EN 46110 to cylinder head retaining bolts (1)
6. Tighten the EN 46110 valve spring compressor nut (2).



7. Install the valve collets using the EN 46117 .



8. Loosen the EN 46110 valve spring compressor nut (2).
9. Remove the EN 46110 to cylinder head retaining bolts (1).
10. Remove the EN 46110 .
11. Disconnect the J 39313 from the compressed air source.
12. Remove the J 39313 .
13. Install the spark plugs. Refer to Spark Plug Replacement.
14. Install the rocker arms and camshafts. Refer to Camshaft Replacement - Left Side.



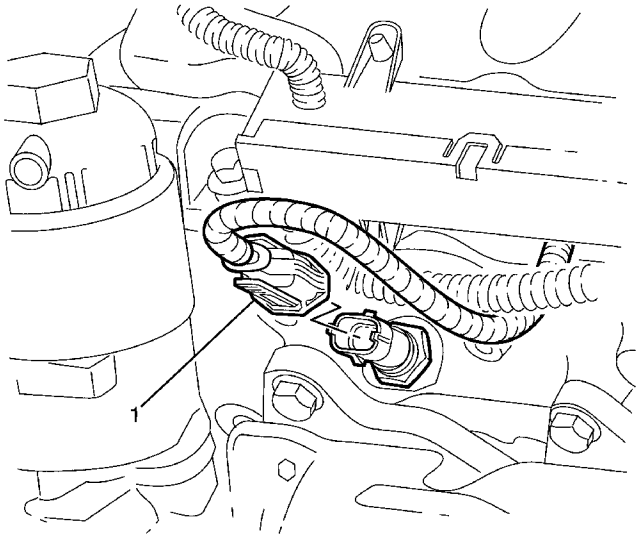
15. Remove the EN 46106 (1).
16. Install the starter motor. Refer to Starter Motor Replacement.

Cylinder Head Replacement - Left Side

Removal Procedure

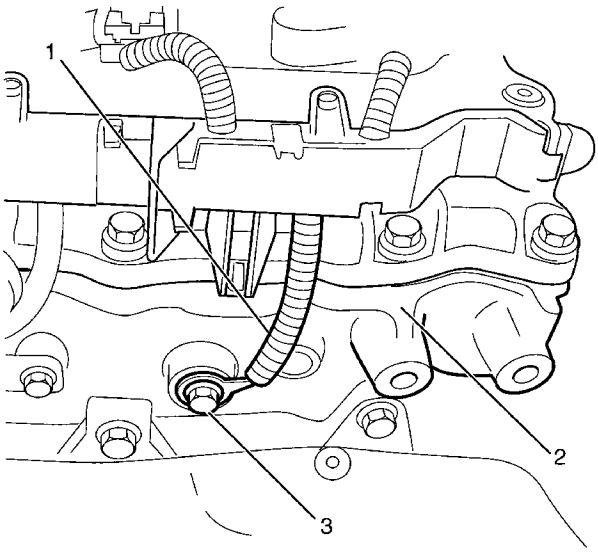
Warning: Refer to Battery Disconnect Warning in the Preface section.

1. Disconnect the battery ground cable. Refer to Battery Negative Cable Disconnection and Connection.
2. Remove the engine covers. Refer to Engine Cover Replacement.
3. Remove the left camshaft cover. Refer to Camshaft Cover Replacement - Left Side.
4. Remove the left bank secondary timing chain. Refer to Secondary Camshaft Drive Chain Replacement - Left Side.
5. Remove the oil level indicator. Refer to Oil Level Indicator and Tube Replacement.

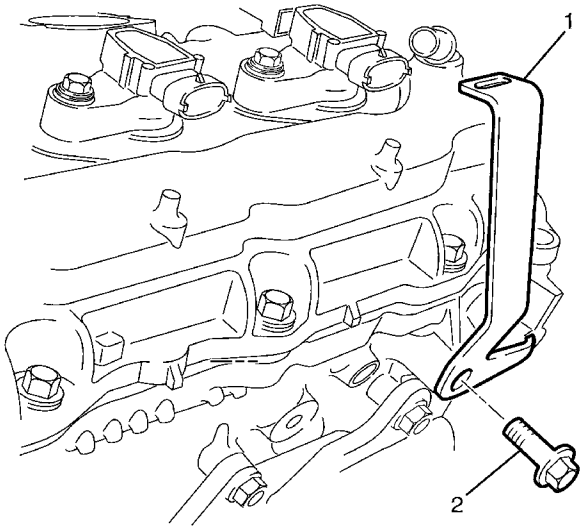


6. Disconnect the coolant temperature sensor electrical connector (1).

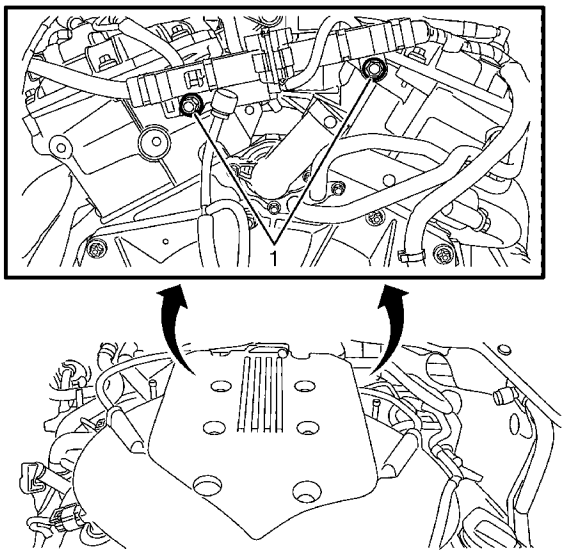
© 2010 General Motors Corporation. All rights reserved.



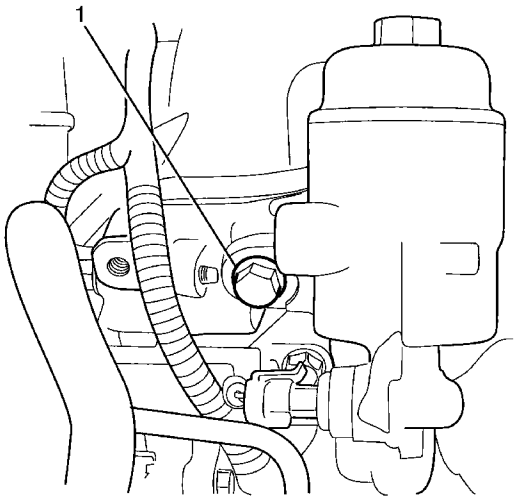
7. Remove the wiring harness ground to cylinder head retaining bolt (3).
8. Remove the wiring harness ground (1) from the cylinder head (2).
9. Remove the upper intake manifold with the lower intake manifold. Refer to Lower Intake Manifold Replacement.



10. Remove the left engine cover mounting bracket to cylinder head retaining bolt (2).
11. Remove the left engine cover mounting bracket (2) from the cylinder head.

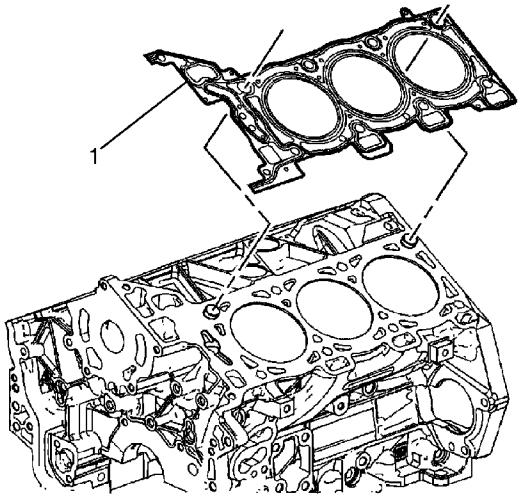


12. Remove the engine wiring harness bracket to cylinder head retaining bolts (1).
13. Remove the catalytic converter. Refer to Catalytic Converter Replacement - Left Side.



Important: DO NOT remove the oil filter adapter.

14. Remove the oil filter adapter upper bolt (1).
15. Remove the cylinder head with the exhaust manifold. Refer to Cylinder Head Removal - Left Side.



Important: Cylinder head gaskets must be discarded whenever the cylinder head has been removed from the cylinder block.

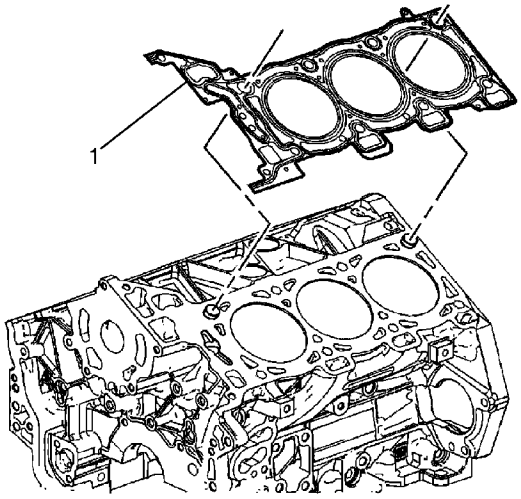
16. Remove the cylinder head gasket (1).

    Discard the gasket.

17. Clean and inspect the cylinder head and the cylinder block sealing surfaces. Refer to Cylinder Head Cleaning and Inspection and Engine Block Cleaning and Inspection.
18. If necessary, perform the following steps:
    - Remove the exhaust manifold from the cylinder head. Refer to Exhaust Manifold Removal - Left Side.
    - Disassemble the cylinder head. Refer to Cylinder Head Disassemble.

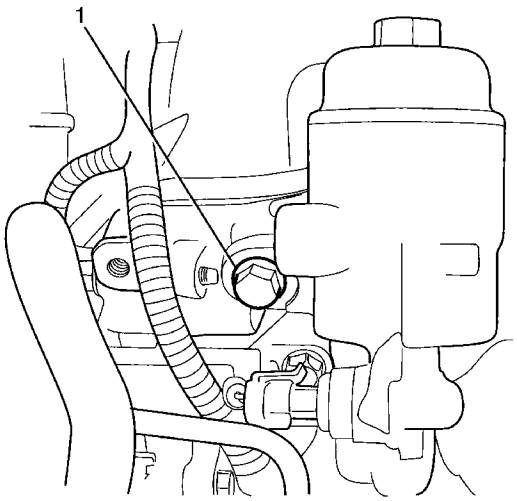
Installation Procedure

1. If necessary, perform the following steps:
    - Assemble the cylinder head. Refer to Cylinder Head Assemble.
    - Install the exhaust manifold to the cylinder head. Refer to Exhaust Manifold Installation - Left Side.

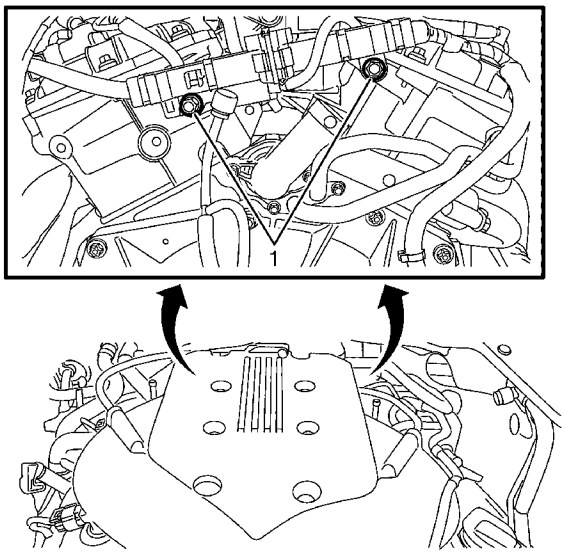


2. Install a NEW cylinder head gasket (1).
3. Install the cylinder head with the exhaust manifold to the engine. Refer to Cylinder Head Installation - Left Side.

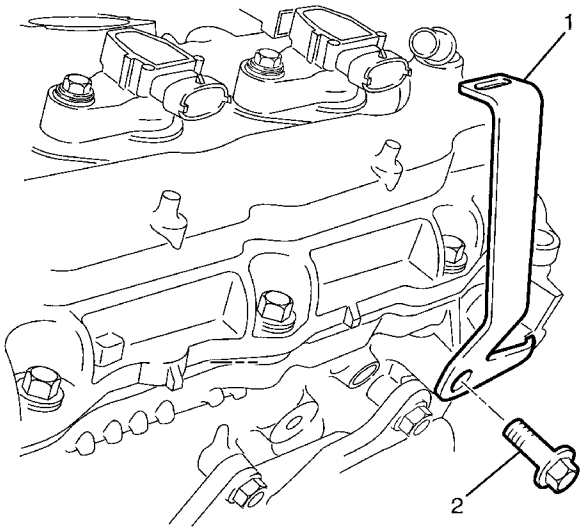
Caution: Refer to Fastener Caution in the Preface section.



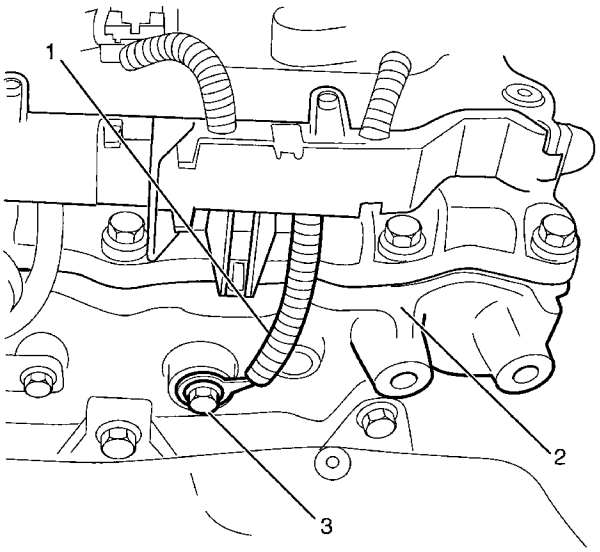
4. Install the oil filter adapter upper retaining bolt (1) and tighten to **65 N·m (48 lb in)**.
5. Install the catalytic converter to the exhaust manifold. Refer to Catalytic Converter Replacement - Left Side.



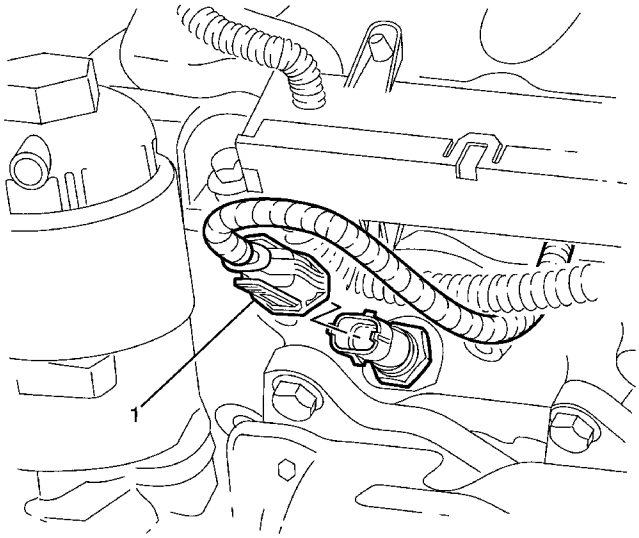
6. Install the wiring harness bracket (2) to the rear of the cylinder head (3).
7. Install the wiring harness bracket using the cylinder head retaining bolts (1) and tighten to **10 N·m (89 lb in)**.



8. Install the left engine cover mounting bracket (2) to the cylinder head.
9. Install the left engine cover mounting bracket using the cylinder head retaining bolt (2) and tighten to **35 N·m (26 lb in)**.
10. Install the left engine cover mounting bracket to cylinder head retaining bolt (2).
11. Install the upper intake manifold with the lower intake manifold. Refer to Lower Intake Manifold Replacement.



12. Install the wiring harness ground (1) to the cylinder head (2).
13. Install the wiring harness ground to the cylinder head retaining bolt (3) and tighten to **10 N·m (89 lb in)**.



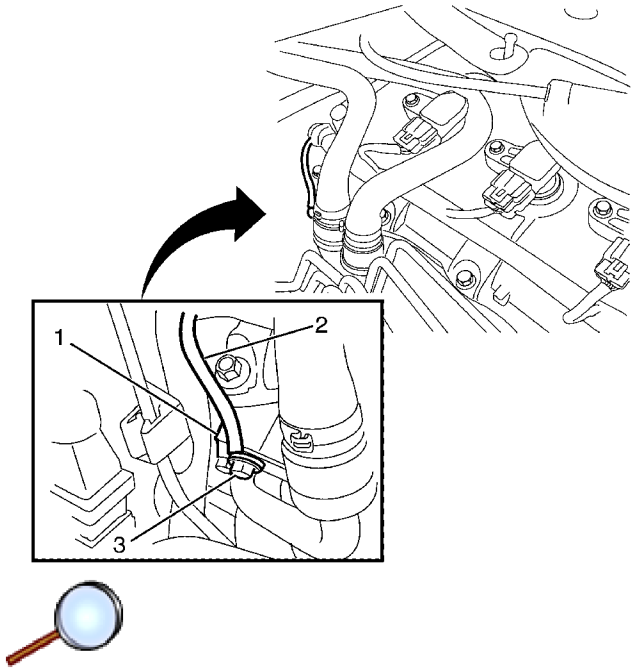
14. Connect the coolant temperature sensor electrical connector (1).
15. Install the oil level indicator. Refer to Oil Level Indicator and Tube Replacement.
16. Install the left bank secondary timing chain. Refer to Secondary Camshaft Drive Chain Replacement - Left Side.
17. Install the left camshaft cover. Refer to Camshaft Cover Replacement - Left Side.
18. Install the engine covers. Refer to Engine Cover Replacement.
19. Connect the battery ground cable. Refer to Battery Negative Cable Disconnection and Connection.

Cylinder Head Replacement - Right Side

Removal Procedure

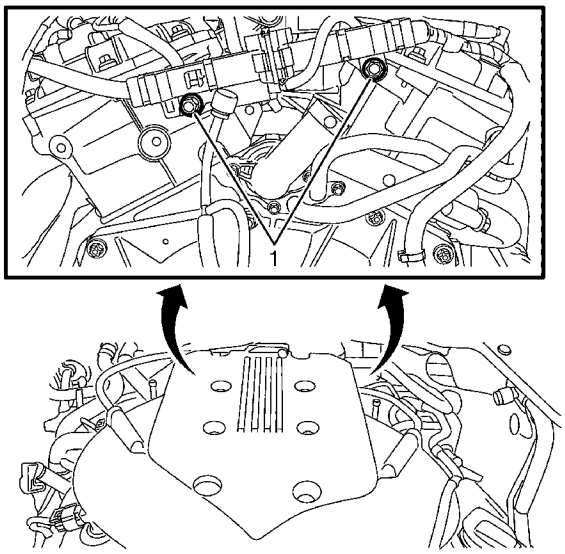
Warning: Refer to Battery Disconnect Warning in the Preface section.

1. Disconnect the battery ground cable. Refer to Battery Negative Cable Disconnection and Connection.
2. Remove the engine covers. Refer to Engine Cover Replacement.
3. Remove the right camshaft cover. Refer to Camshaft Cover Replacement - Right Side.
4. Remove the left bank secondary timing chain. Refer to Secondary Camshaft Drive Chain Replacement - Left Side.

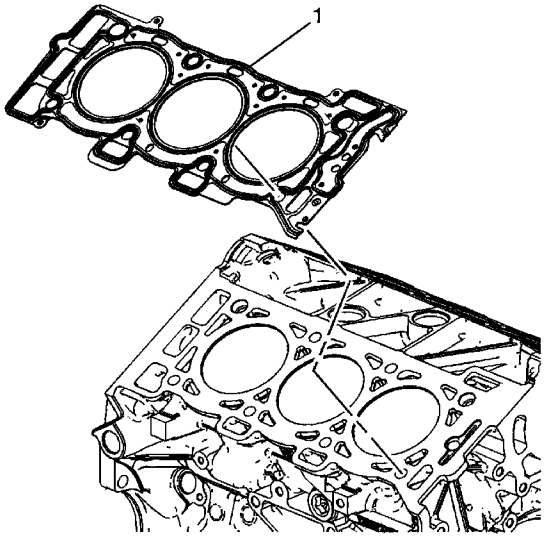


5. Remove the wiring harness ground to cylinder head retaining bolts (1).
6. Remove the wiring harness ground (2) from the side of the cylinder head (3).
7. Remove the coolant inlet pipe. Refer to Engine Coolant Inlet Pipe Replacement.

© 2010 General Motors Corporation. All rights reserved.



8. Remove the engine wiring harness bracket to cylinder head retaining bolts (1).
9. Remove the catalytic converter. Refer to Catalytic Converter Replacement - Right Side.
10. Remove the cylinder head with the exhaust manifold. Refer to Cylinder Head Removal - Right Side.



Note: Cylinder head gaskets must be discarded whenever the cylinder head has been removed from the cylinder block

11. Remove and discard the cylinder head gasket (1).

    Discard the gasket

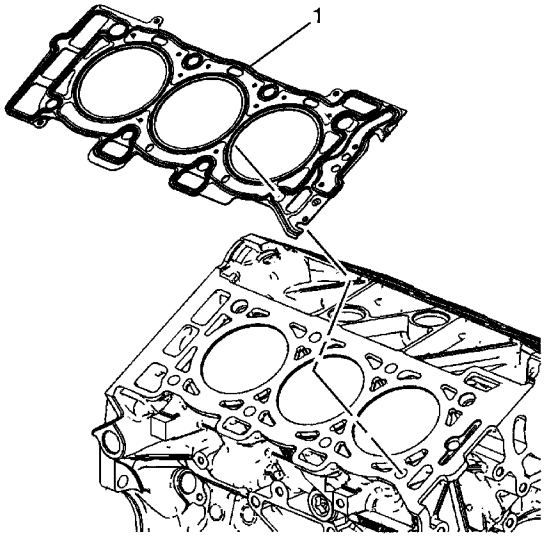
12. Clean and inspect the cylinder head and the cylinder block sealing surfaces. Refer to Cylinder

Head Cleaning and Inspection and Engine Block Cleaning and Inspection.

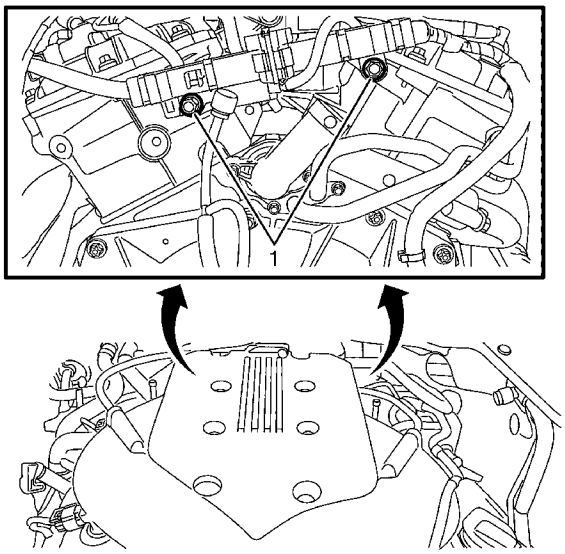
13. If necessary, perform the following steps:
    - Remove the exhaust manifold from the cylinder head. Refer to Exhaust Manifold Removal - Right Side.
    - Disassemble the cylinder head. Refer to Cylinder Head Disassemble.

Installation Procedure

1. If necessary, perform the following steps:
    - Assemble the cylinder head. Refer to Cylinder Head Assemble.
    - Install the exhaust manifold to the cylinder head. Refer to Exhaust Manifold Installation - Right Side.



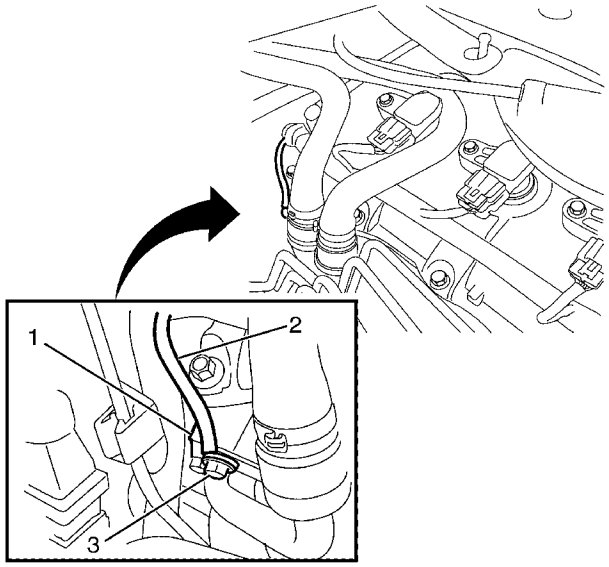
2. Install a NEW cylinder head gasket (1).
3. Install the cylinder head with the exhaust manifold to the engine. Refer to Cylinder Head Installation - Right Side.
4. Install the catalytic converter to the exhaust manifold. Refer to Catalytic Converter Replacement - Right Side.



5. Install the engine wiring harness bracket to cylinder head retaining bolts (1).

   Caution: Refer to Fastener Caution in the Preface section.

6. Install the wiring harness bracket using the cylinder head retaining bolts (1) and tighten to **10 N·m (89 lb in)**.



7. Install the wiring harness ground to the side of the cylinder head.
8. Install the wiring harness ground to the right cylinder head retaining bolt (3) and tighten to **10 N·m (89 lb in)**.
9. Install the coolant inlet pipe. Refer to Engine Coolant Inlet Pipe Replacement.
10. Install the left bank secondary timing chain. Refer to Secondary Camshaft Drive Chain Replacement - Left Side.
11. Install the right camshaft cover. Refer to Camshaft Cover Replacement - Right Side.

12. Install the engine covers. Refer to Engine Cover Replacement.
13. Connect the battery ground cable. Refer to Battery Negative Cable Disconnection and Connection.

Engine Flywheel Replacement

Removal Procedure

1. Remove the transmission. Refer to Transmission Replacement
2. Remove the engine flywheel. Refer to Engine Flywheel Removal

Installation Procedure

1. Install the engine flywheel. Refer to Engine Flywheel Installation
2. Install the transmission. Refer to Transmission Replacement

© 2010 General Motors Corporation. All rights reserved.

Crankshaft Rear Oil Seal and Housing Replacement

Removal Procedure

1. Remove the engine flywheel. Refer to Engine Flywheel Replacement.
2. Remove the oil pan. Refer to Oil Pan Replacement.
3. Remove the crankshaft rear oil seal and housing. Refer to Crankshaft Rear Oil Seal and Housing Removal.

Installation Procedure

1. Install the crankshaft rear oil seal and housing. Refer to Crankshaft Rear Oil Seal and Housing Installation.
2. Install the oil pan. Refer to Oil Pan Replacement.
3. Install the engine flywheel. Refer to Engine Flywheel Replacement.

© 2010 General Motors Corporation. All rights reserved.

Oil Pump Replacement

Removal Procedure

1. Remove the engine covers. Refer to Engine Cover Replacement.
2. Remove the spark plugs in order to ease crankshaft/engine rotation. Refer to Spark Plug Replacement.
3. Remove the engine front cover. Refer to Engine Front Cover Replacement.

Important: DO NOT remove the left bank idler sprocket.

4. Remove the primary timing chain. Refer to Primary Camshaft Intermediate Drive Chain Removal.
5. Remove the crankshaft sprocket. Refer to Crankshaft Sprocket Removal.
6. Remove the oil pump bolts and the oil pump. Refer to Oil Pump Removal.
7. Perform the following steps as necessary:
   - Disassemble the oil pump. Refer to Oil Pump Disassemble.
   - Clean and inspect the oil pump. Refer to Oil Pump Disassemble.

Installation Procedure

1. Assemble the oil pump as necessary. Refer to Oil Pump Assemble.
2. Install the oil pump. Refer to Oil Pump Installation.
3. Install the crankshaft sprocket. Refer to Crankshaft Sprocket Installation.
4. Install the primary timing chain. Refer to Primary Camshaft Intermediate Drive Chain Installation.
5. Install the spark plugs. Refer to Spark Plug Replacement.
6. Install the engine front cover. Refer to Engine Front Cover Replacement.
7. Install the engine covers. Refer to Engine Cover Replacement.

© 2010 General Motors Corporation. All rights reserved.

Oil Pan Replacement

Removal Procedure

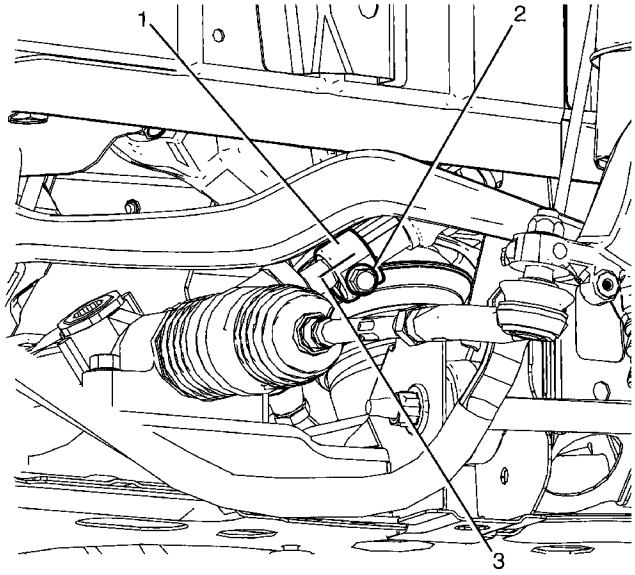
Warning: Refer to Battery Disconnect Warning in the Preface section.

1. Disconnect the battery ground cable. Refer to Battery Negative Cable Disconnection and Connection.

Warning: Refer to Safety Glasses Warning in the Preface section.

Danger: To avoid any vehicle damage, serious personal injury or death when major components are removed from the vehicle and the vehicle is supported by a hoist, support the vehicle with jack stands at the opposite end from which the components are being removed and strap the vehicle to the hoist.

2. Raise and support the vehicle. Refer to Lifting and Jacking the Vehicle.
3. Drain the engine oil. Refer to Engine Oil and Oil Filter Replacement.
4. Remove the engine splash shield. Refer to Engine Splash Shield Replacement.
5. Remove the front air deflector. Refer to Front Air Deflector Replacement.



Note: Observing the orientation of the intermediate steering shaft (1) with reference to the pinion shaft (3) will minimise the potential of incorrect steering column assembly alignment.

6. Mark the intermediate steering shaft (1) in relation to the pinion shaft (3).

Note: Bolts with micro-encapsulated thread sealant must be discarded after removal.

7. Remove the intermediate steering shaft to pinion shaft retaining bolt (2) and discard.

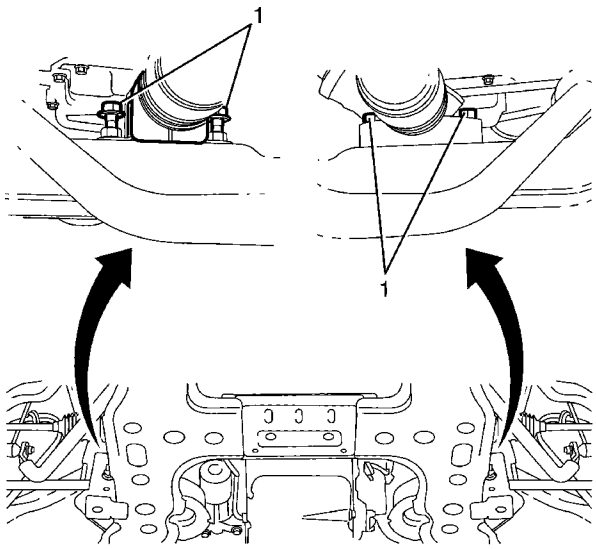
Copyright © 2010 General Motors Corporation. All rights reserved.

Discard the bolt.

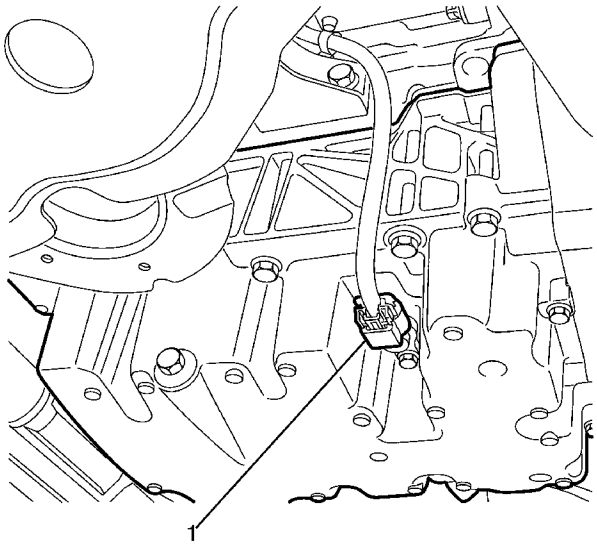
Note: Make sure all the bolt hole is thoroughly cleaned and all micro-encapsulated thread sealant is removed.

8. Disconnect the intermediate shaft (2) from the pinion shaft (3).

   Clean the bolt hole.

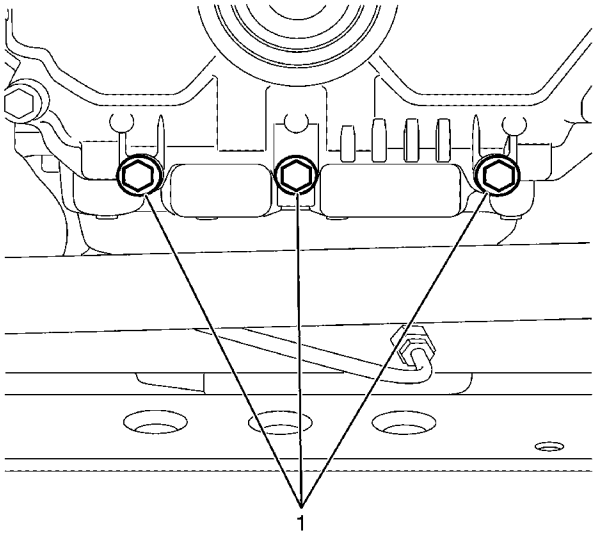


9. Remove the steering gear to subframe retaining bolts (1).
10. Slide the steering gear forward to gain full access to the sump.

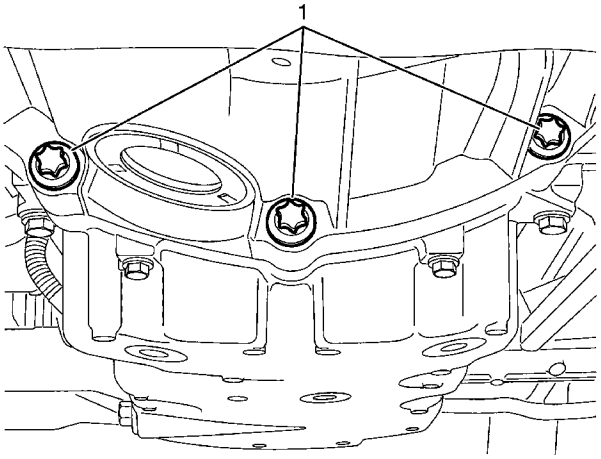


11. Disconnect the oil level/temperature sensor electrical connector (1) from the oil

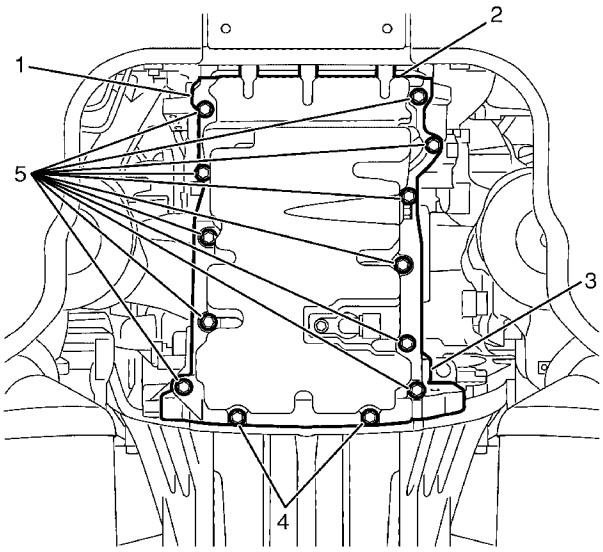
level/temperature sensor.



12. Remove the front cover to oil pan retaining bolts (1).



13. Remove the transmission to oil pan retaining bolts (1).



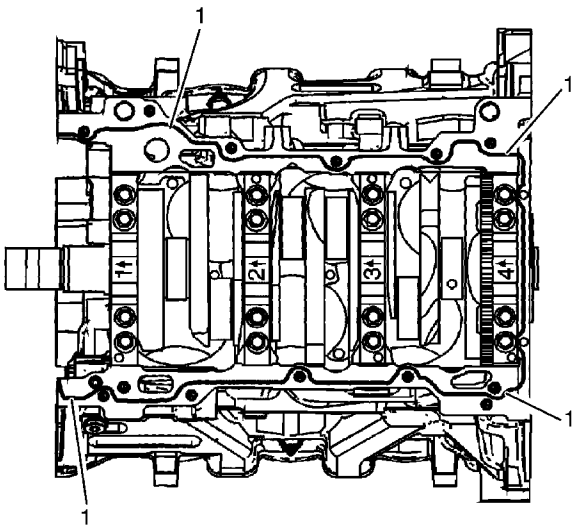
14. Remove the rear oil pan to cylinder block retaining bolts (4).
15. Remove the oil pan to cylinder block retaining bolts (5).

Note: Using the pry points (1 and 3) to shear the RTV sealant.

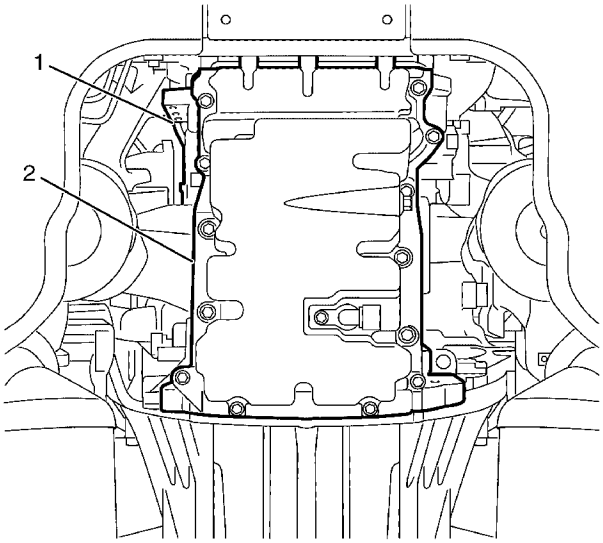
16. Remove the oil pan (2) from the engine block.
17. Perform the following steps as necessary.
    - Disassemble the oil pan. Refer to Oil Pan Disassemble.
    - Clean and inspect the oil pan. Refer to Oil Pan Cleaning and Inspection.

Installation Procedure

1. Assemble the oil pan as necessary. Refer to Oil Pan Assemble.

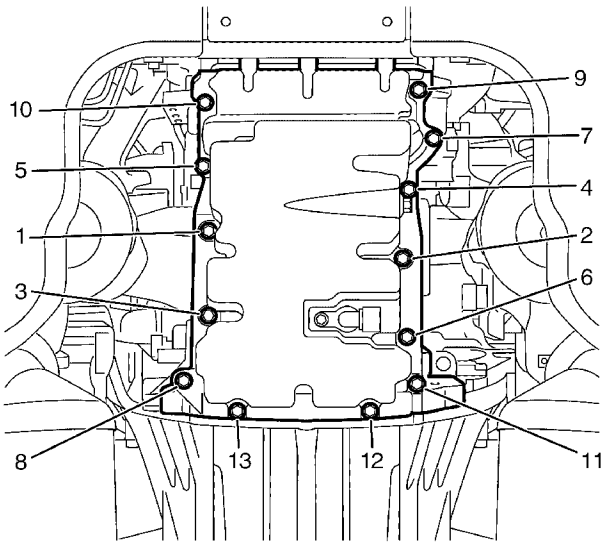


2. Place a three mm (0.118 in) bead of RTV sealant (1) on the block pan rail and the crankshaft rear oil seal housing.

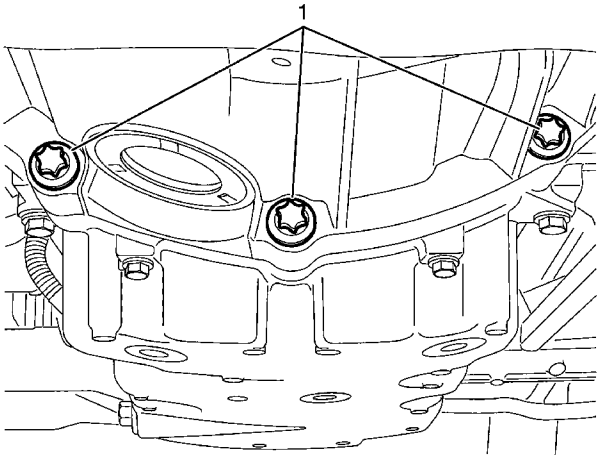


3. Position the oil pan (1) onto the engine block (2).

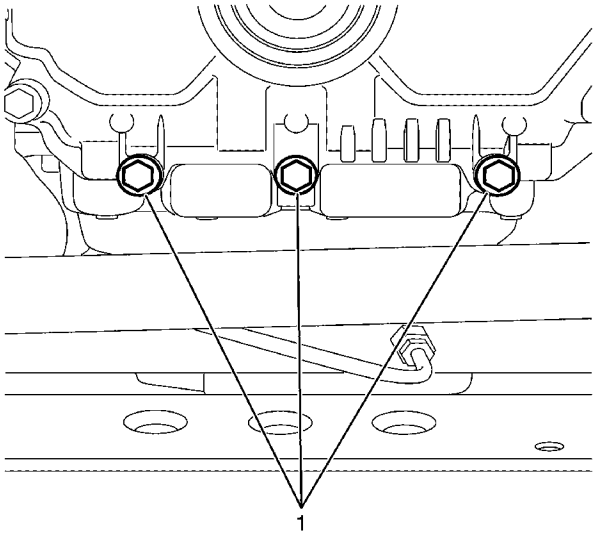
Caution: Refer to Fastener Caution in the Preface section.



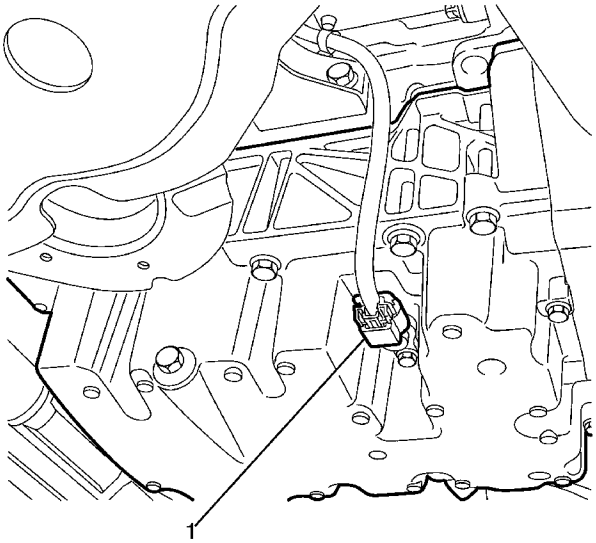
4. Install the oil pan to cylinder block retaining bolts in the sequence shown and tighten..
   - the eight mm bolts (1-11) to **23 N·m (17 lb ft)**
   - the six mm bolts (12, 13) to **10 N·m (89 lb in)**



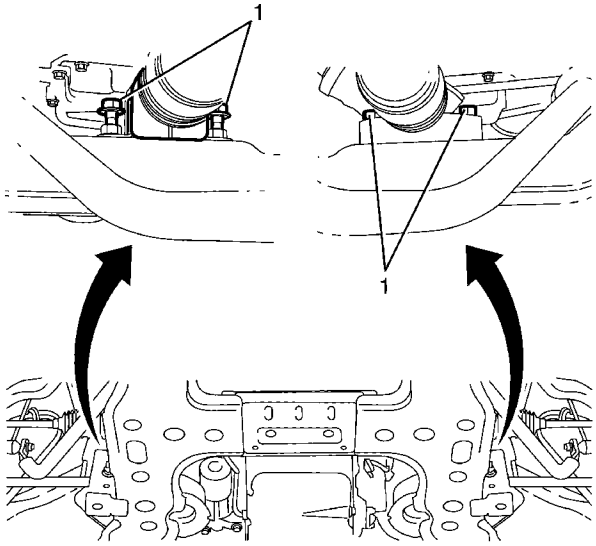
5. Install the transmission to the oil pan retaining bolts (1) and tighten to **48 N·m (17 lb ft)**.



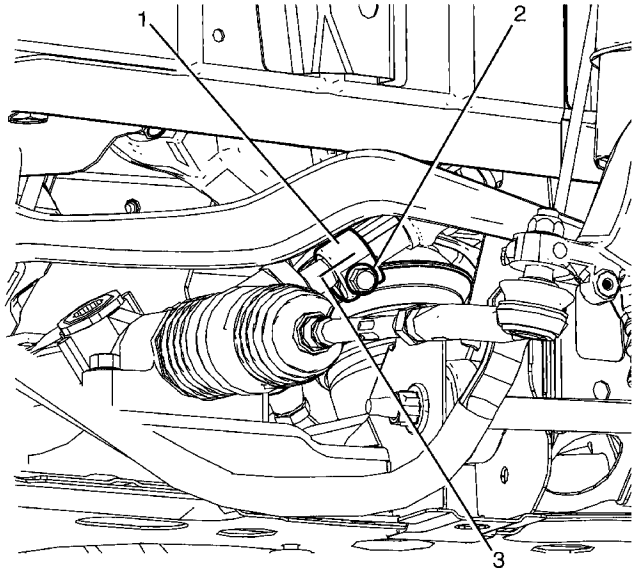
6. Install the front cover using the oil pan retaining bolts (1) and tighten to **23 N·m (17 lb ft)**.



7. Connect the oil level/temperature sensor electrical connector (1) to the oil level/temperature sensor.
8. Position the steering gear in the correct location.



9. Install the steering gear using the subframe retaining bolts (1) and tighten to **65 N·m (48 lb ft)**.



Note: The intermediate steering shaft and pinion shaft splines must be installed in the position recorded during removal and aligned with the marks previously made.

10. Connect the intermediate steering shaft (1) to the pinion shaft (3).
11. Install the NEW intermediate steering shaft to the pinion shaft retaining bolt (2) and tighten to **25 N·m (16 lb ft)**.
12. Install the engine splash shield. Refer to Engine Splash Shield Replacement.
13. Install the front air deflector. Refer to Front Air Deflector Replacement.
14. Lower the vehicle to the ground
15. Fill the engine with new engine oil. Refer to Engine Oil and Oil Filter Replacement.
16. Connect the battery ground cable. Refer to Battery Negative Cable Disconnection and Connection.

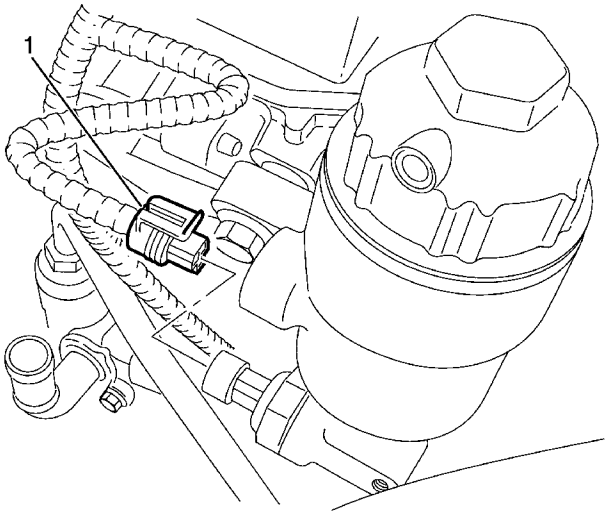
Engine Oil Pressure Sensor and/or Switch Replacement

Special Tools

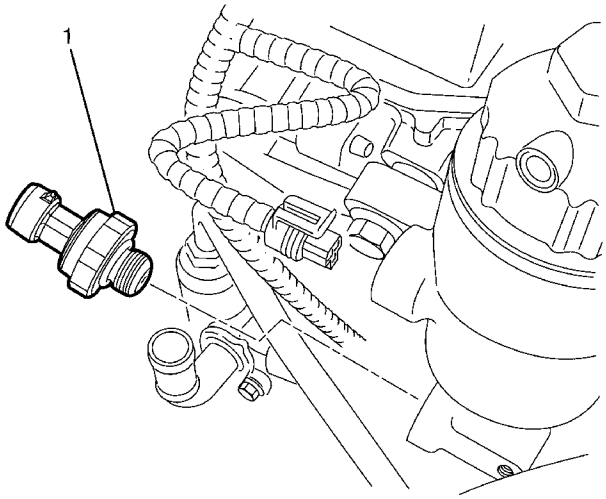
J 41712 Oil Pressure Sensor Socket

Removal Procedure

1. Turn the ignition OFF.
2. Remove the left hand engine cover. Refer to Engine Cover Replacement.



3. Disconnect the oil pressure sensor electrical connector (1).



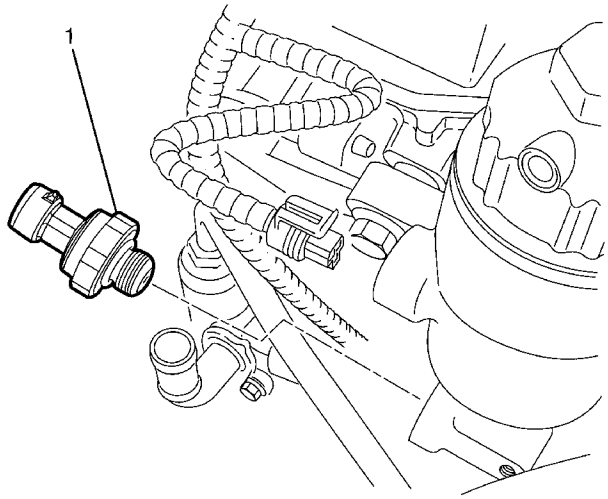
© 2010 General Motors Corporation. All rights reserved.

Note: A small amount of oil will drain out of the oil filter housing when the oil pressure sensor is removed. Use a shop towel to absorb the oil.

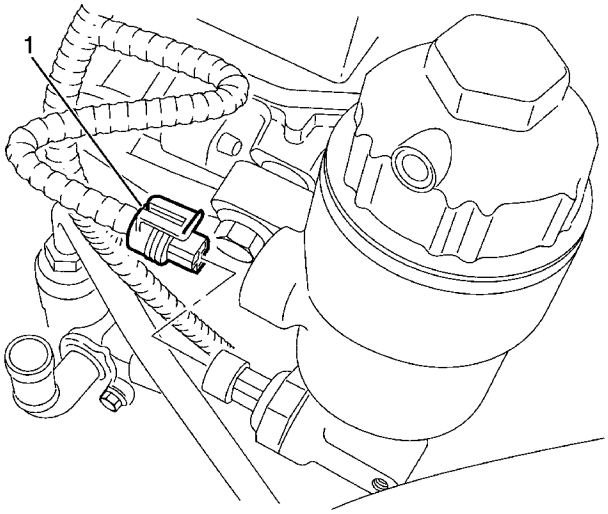
4. Use the J 41712 in order to remove the oil pressure sensor (1).

Installation Procedure

Caution: Refer to Fastener Caution in the Preface section.



1. Use the J 41712 in order to install the oil pressure sensor (1) and tighten to **20 N·m (15 lb ft)**.



2. Connect the oil pressure sensor electrical connector (1).
3. Install the left hand engine cover. Refer to Engine Cover Replacement.

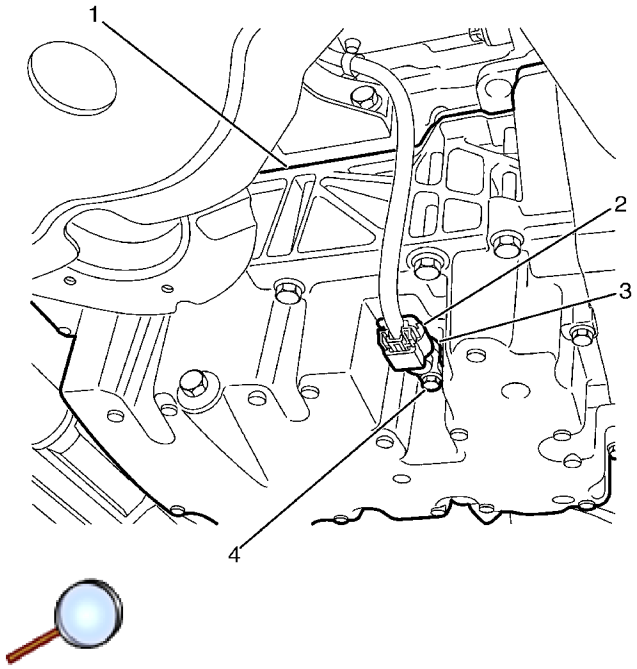
Engine Oil Level Sensor and/or Switch Replacement

Removal Procedure

Warning: Refer to Safety Glasses Warning in the Preface section.

Danger: To avoid any vehicle damage, serious personal injury or death when major components are removed from the vehicle and the vehicle is supported by a hoist, support the vehicle with jack stands at the opposite end from which the components are being removed and strap the vehicle to the hoist.

1. Raise and support the vehicle. Refer to Lifting and Jacking the Vehicle.
2. Remove the Engine Splash Shield. Refer to Engine Splash Shield Replacement.

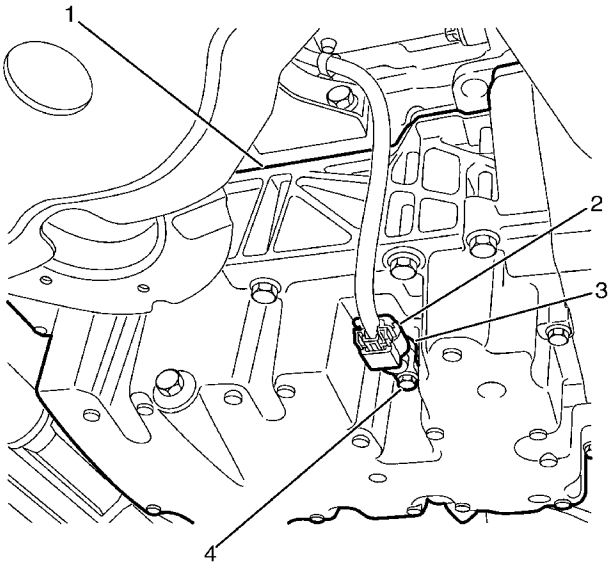


3. Drain the engine oil. Refer to Engine Oil and Oil Filter Replacement.
4. Disconnect the engine oil level switch electrical connector (2).
5. Remove the engine oil level switch to oil pan retaining bolt (4).
6. Remove the engine oil level switch (3) from the oil pan (1).

Installation Procedure

Caution: Refer to Fastener Caution in the Preface section.

© 2010 General Motors Corporation. All rights reserved.

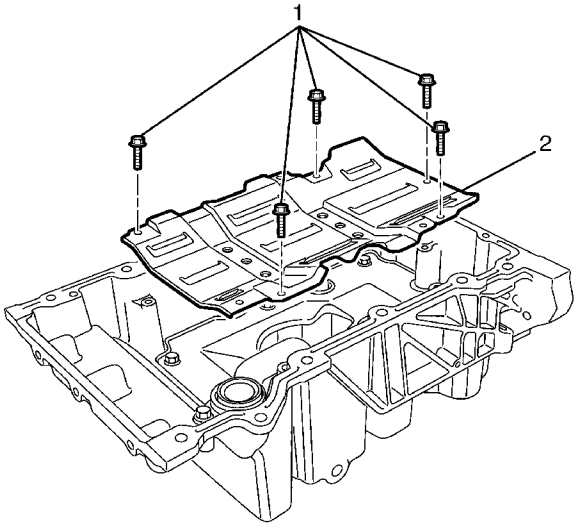


1. Install the engine oil level switch bolt (2) to the oil pan (3) and tighten to **20 N·m (15 lb ft)**.
2. Connect the engine oil level switch electrical connector (1).
3. Install the front air deflector. Refer to Front Air Deflector Replacement.
4. Lower the vehicle.
5. Fill the engine oil. Refer to Engine Oil and Oil Filter Replacement.
6. Inspect for oil leaks after engine start up.
7. Reset the GM Oil Life System. Refer to GM Oil Life System Resetting.

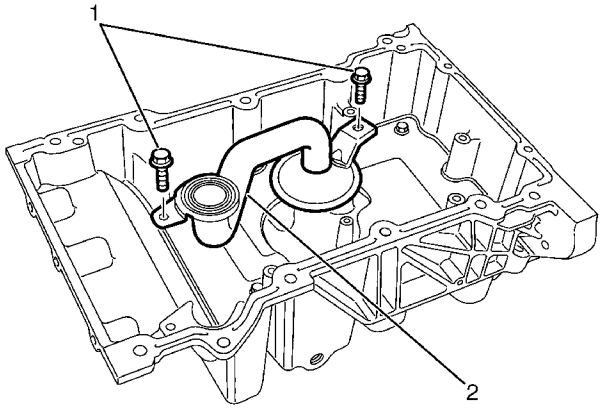
Oil Pump Suction Pipe and Screen Assembly Replacement

Removal Procedure

1. Remove the oil pan. Refer to Oil Pan Replacement.



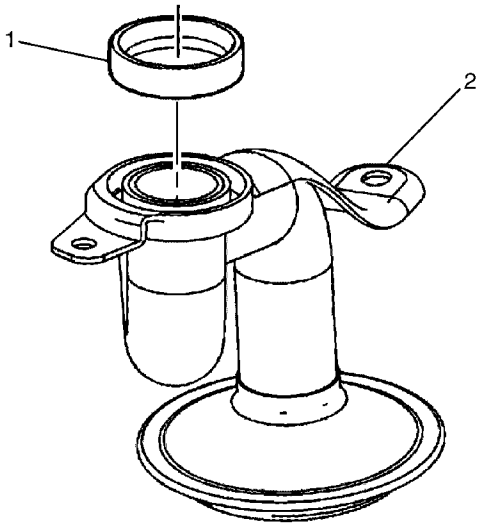
2. Remove the oil pan scraper bolts (1).
3. Remove the oil pan scraper (2).



4. Remove the oil suction pipe to oil pan retaining bolts (1).

© 2010 General Motors Corporation. All rights reserved.

5. Remove the oil suction pipe (2).

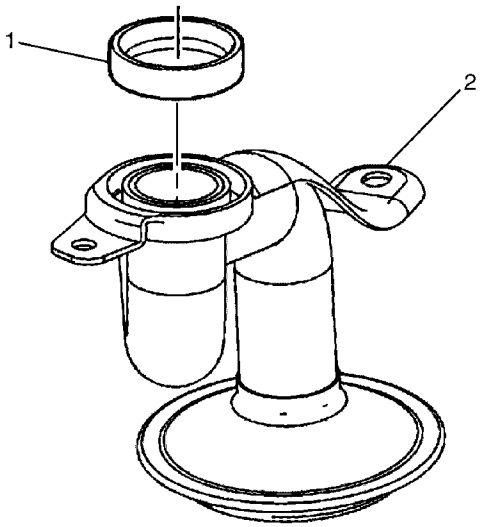


Note: The oil suction pipe seal (1) is a single use component and must be discarded whenever the oil suction pipe (2) is removed.

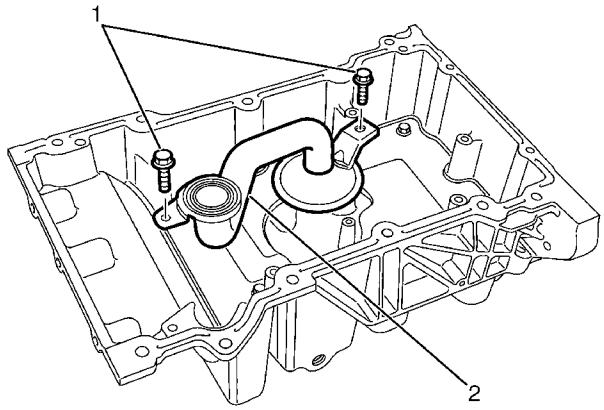
6. Remove the oil suction pipe seal (1) from the oil suction pipe (2).

   Discard the oil suction pipe seal (1).

Installation Procedure



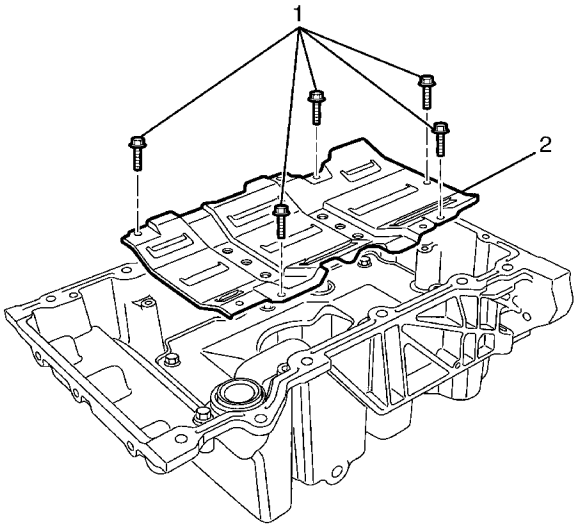
1. Install a NEW oil suction pipe seal (1) onto the oil suction pipe (2).



2. Install the oil suction pipe (2).

Caution: Refer to Fastener Caution in the Preface section.

3. Install the oil suction pipe using the oil pan retaining bolts (1) and tighten to **10 N·m (89 lb in)**.

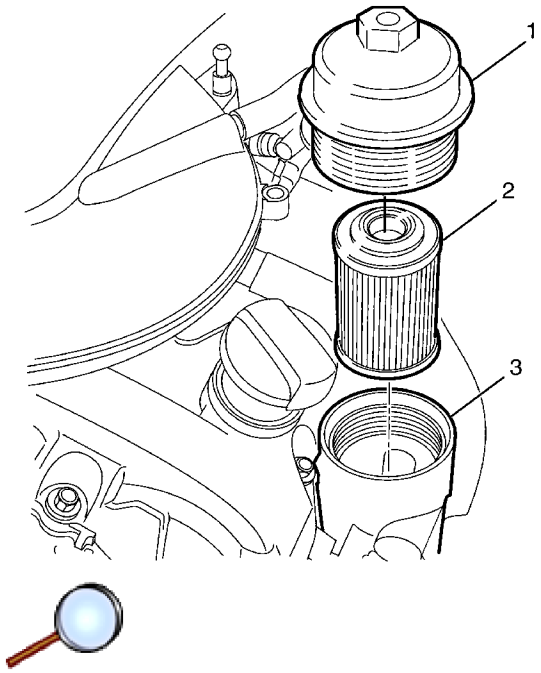


4. Install the oil pan scraper (2).
5. Install the oil pan scraper to the oil pan retaining bolts (1) and tighten to **10 N·m (89 lb in)**.
6. Install the oil pan. Refer to Oil Pan Replacement.

Engine Oil and Oil Filter Replacement

Removal Procedure

1. Turn the ignition OFF.



Note: Use a six-point socket to remove the oil filter cap (1).

2. Remove the oil filter adapter cap (1) from the engine oil filter adapter (3).

Note: The oil filter cartridge (2) must be replaced at every service interval.

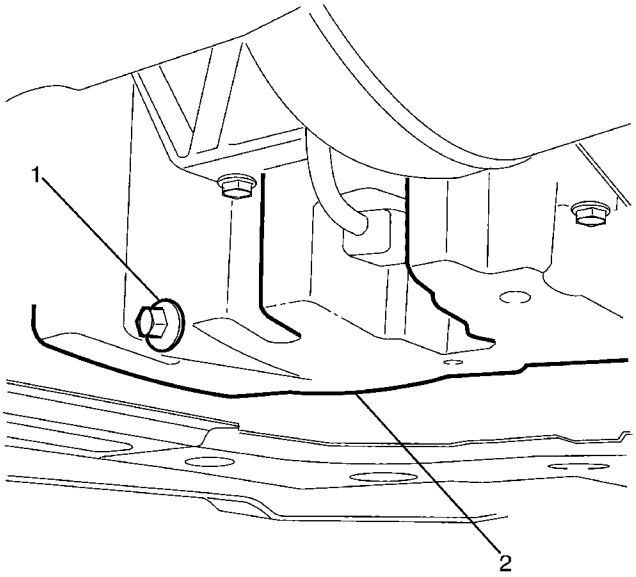
3. Remove the oil filter cartridge (2).

Discard the oil filter cartridge (2).

Warning: Refer to Safety Glasses Warning in the Preface section.

4. Raise and support the vehicle. Refer to Lifting and Jacking the Vehicle.

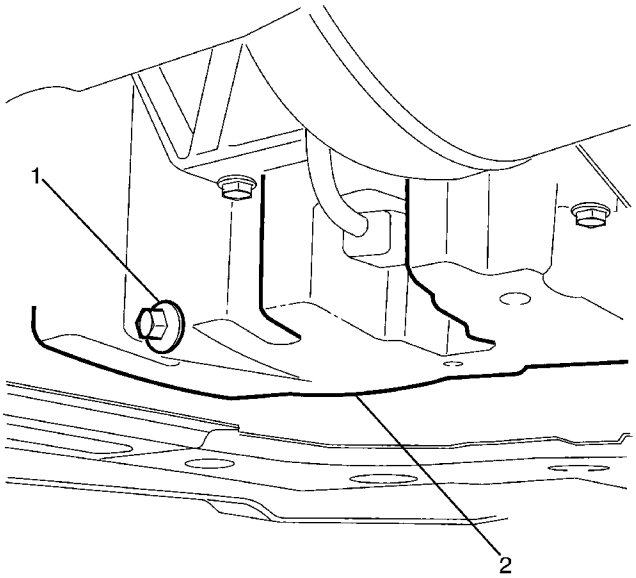
© 2010 General Motors Corporation. All rights reserved.



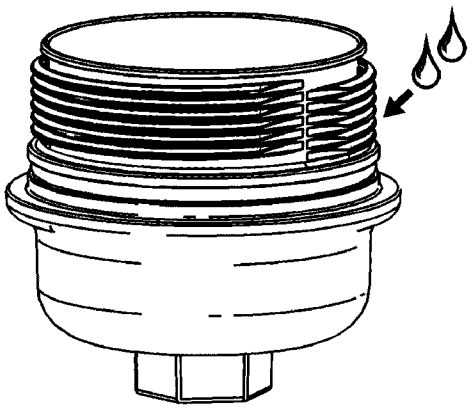
5. Place a suitable container below the oil pan drain plug (1).
6. Remove the oil pan drain plug (1) from the oil pan (2).
7. Allow the oil to drain completely.

Installation Procedure

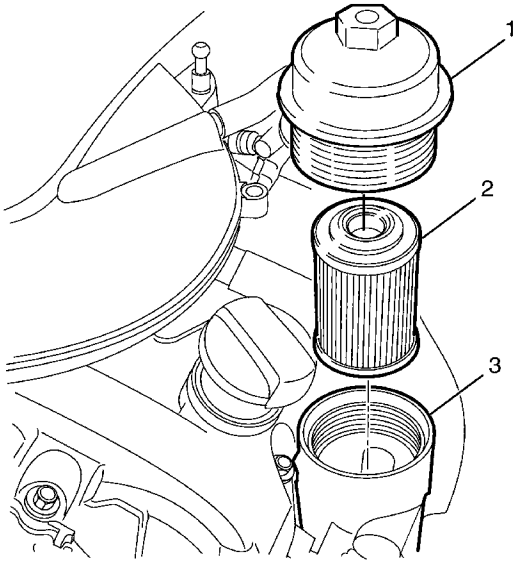
Caution: Refer to Fastener Caution in the Preface section.



1. Install the oil pan drain plug (1) to the oil pan (2) and tighten to **25 N·m (18 lb ft)**.
2. Lower the vehicle.



3. Lubricate the oil filter cap threads with clean engine oil.



4. Install the NEW oil filter cartridge (2).

Note: Use a six-point socket to install the oil filter cap.

5. Install the oil filter cap (1) to the engine oil filter adapter (3) and tighten to **25 N·m (18 lb ft)**.
6. Fill the engine with the appropriate oil type and quantity. Refer to Fluid and Lubricant Recommendations and Approximate Fluid Capacities.
7. Reset the service reminder display. Refer to Service Display Reminders.